In Two Parts
PART ONE

January, 1934

Railway Engineering and Maintenance

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greetings. We are confident that this trend will con-
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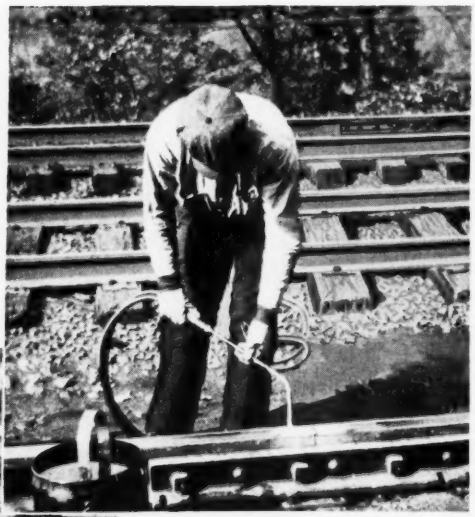

Above: Heating the rail ends with AIRCO-D-B Style No. 9800 Oxyacetylene Torch.

Above: Using pyrometer to determine correct quenching temperature.

At left: Quenching rail ends.

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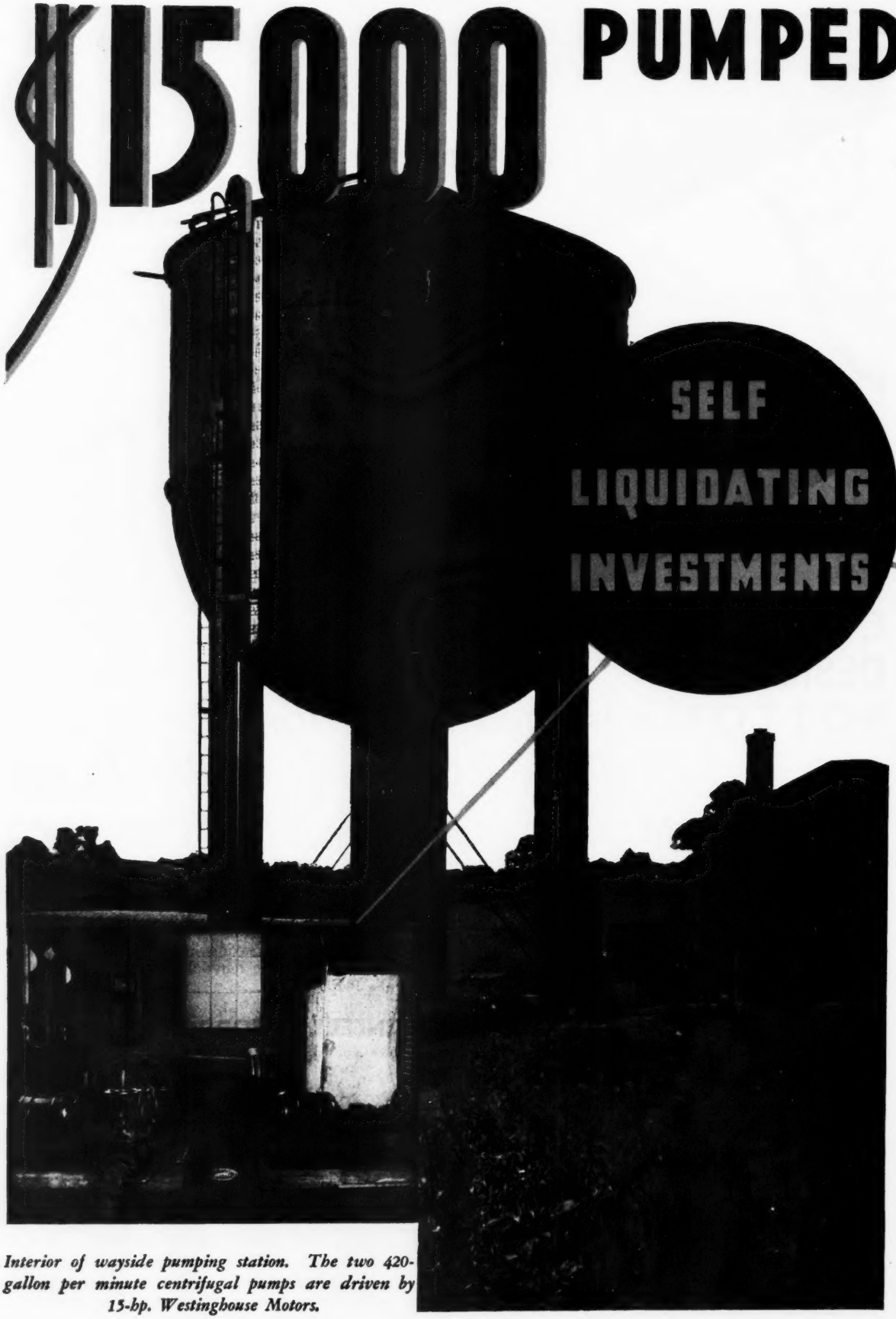

Interior of wayside pumping station. The two 420-gallon per minute centrifugal pumps are driven by 15-hp. Westinghouse Motors.

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WITH ELECTRIC MOTOR DRIVE

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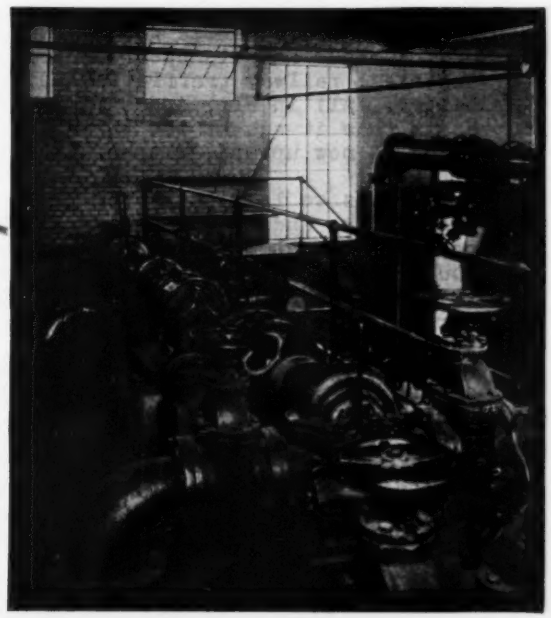

Interior of a recently modernized pump house and water treating plant. Westinghouse motors are used.

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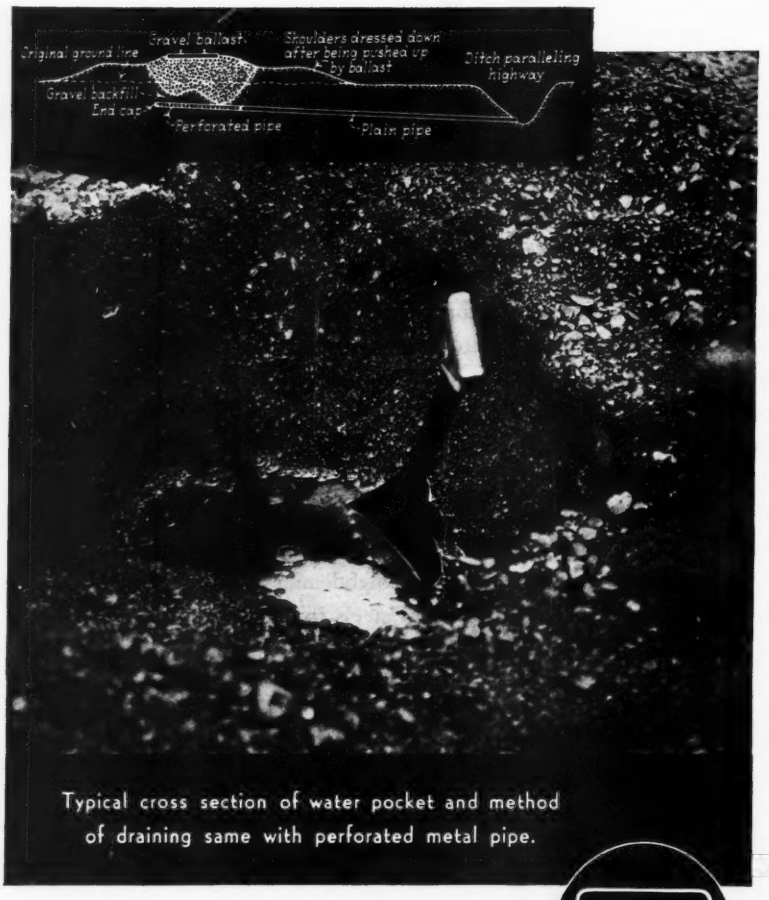

Typical cross section of water pocket and method of draining same with perforated metal pipe.

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Railway Engineering and Maintenance

NAME REGISTERED U. S. PATENT OFFICE

JANUARY, 1934

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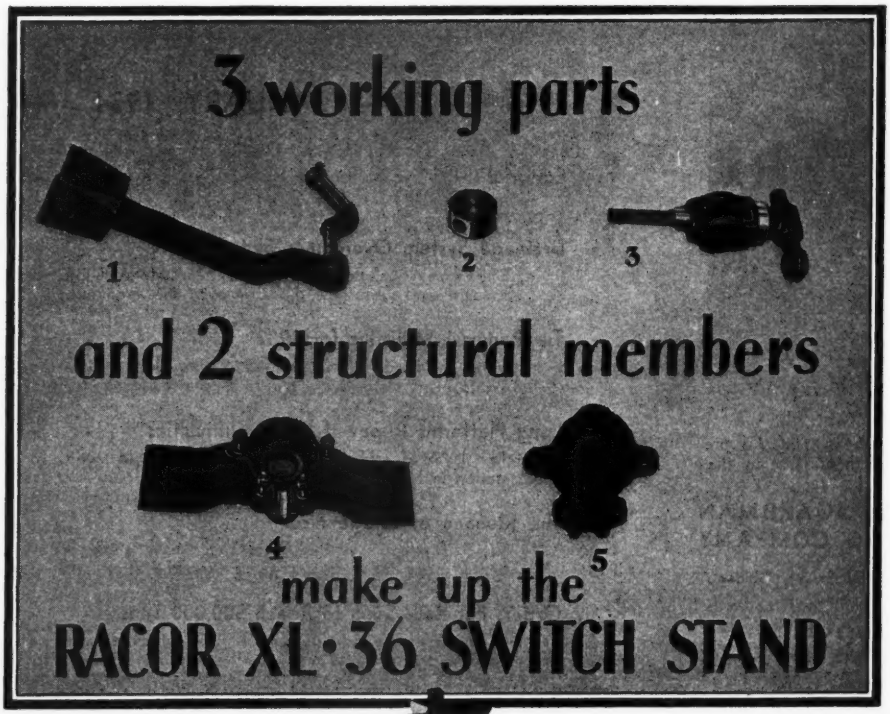
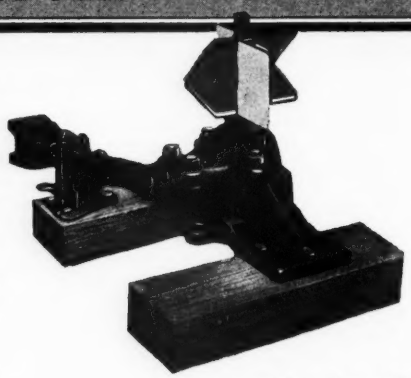
IT'S SO SIMPLE





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Railway Engineering and Maintenance

1933

A Year of Discouragement and of Hope

THE year that has just closed has, in many respects, been one of continued disappointment. It was the fourth successive year of declining activity and established many new low records. Yet in mid-year the trend changed and the recovery in the last six months, while somewhat irregular, went far to erase the declines of the early months and in numerous instances resulted in actual increases in activities for the year, as compared with 1932. Of far greater importance, however, is the fact that the trend at the end of the year was upward, in marked contrast with that at the beginning of the year, and this has led to the feeling that the force of the depression has been broken and that the forces of recovery will make themselves felt to an increasing degree. This change in trend, which has been in evidence since May, is the outstanding event of the year.

While this change occurred first in industry, it became apparent quickly in railway traffic, for the railways afford a most accurate cross section of the degree of activity of industry at large, through their service in moving raw materials into and finished products out of the factories of the country. As a result, the carloadings have furnished an almost immediate index of improvement in the steel and other industries. Carloadings have also furnished an index of railway earnings weeks before the actual figures became available. Earnings have in turn been reflected in increased allowances for materials and labor for needed repair and rehabilitation. As a result, the railways ended the year on a higher level of activity than that on which they entered it, while their outlook is now upward, in contrast with a downward inclination a year ago.

The Year's Record

The change in trend is shown in the following summary of the year's operations:

Freight traffic was 8 per cent heavier in 1933 than in 1932. In the preceding year it declined 24 per cent.

Passenger traffic decreased 3 per cent as compared with 1932. In the preceding year it declined 23 per cent.

Gross operating revenues were approximately 1 per cent less than in 1932. They declined 25.4 per cent in the preceding year.

Operating expenses were reduced about 6 per cent in 1933. They were cut 25.6 per cent in 1932.

Net railway operating income increased approximately 16 per cent in 1933. It declined 38 per cent in 1932. The roads as a whole will approximate their fixed charges this year, whereas they fell short of this goal last year by $153,308,487.

The rate of return on property investment was 1.77 per cent, as compared with 1.23 per cent last year.

Such changes are of fundamental significance to those concerned with the upkeep and improvement of railway roadway and structures. For four years retrenchment has been the order and working programs have been based, not on the needs of the properties, but on the amount of money available. As earnings have declined month after month, it has been necessary to put into effect one retrenchment measure after another, until of late upkeep has fallen far short of making good the current wear and tear, let alone continuing the program of improvement that is necessary to keep a large railway abreast of changes in the demands of its patrons.

The Decline in Maintenance Expenditures

Thus, expenditures for maintenance of way in 1930 declined 18 per cent from those in 1929; in 1931 they were 25 per cent less than in 1930; in 1932 they were 34 per cent below those for 1931, and in the first six months of 1933 they were 20 per cent less than for the corresponding period of 1932, or less than 35 per cent of the figure for the first half of 1929.

Beginning with July, however, expenditures for maintenance of way have exceeded those for the same months of 1932, although these increases have not yet been sufficient to offset the decreases of the earlier months and the total for 1933 was less than for any year since 1909 or since labor and materials rose to their present levels.

It is significant in this connection that the total expenditures for maintenance of way in the four years 1930-1933, inclusive, approximated $1,912,263,000, as compared with $3,428,661,000 for the four years 1926-1929 inclusive, a decrease between these two four-year periods of more than $1,500,000,000. Taking into full account the reduction in wear and tear resulting from the decline in traffic, the increased return secured per dollar of expenditure for both labor and material and other compensating factors, it has been estimated that the railways should spend at least $700,000,000 to restore their fixed properties to the standards that prevailed in 1929.

In support of these figures, the annual expenditures for maintenance of way and structures of the Class I roads, excluding switching and terminal companies, for recent years are given in the following column.

The trend indicated by the expenditures is shown also by the figures with respect to labor, although the decline is not so great. For years, the average number of employees engaged in maintenance of way activities ap-

proximated 400,000, while the monthly averages have fluctuated between 330,000 in the winter months and 475,000 in the peak of the summer working season. In the four years 1926-1929 inclusive, the average annual force was 412,777. In 1930 this annual average declined to 349,202; in 1931 to 275,486 and in 1932 to 215,887, while in 1933 it approximated 198,000.

This was the first time since 1889 that the number of maintenance of way employees has averaged less than 200,000 for an entire year. It is significant also that the *maximum* average force in any month last year was only 224,753, in September, or only two-thirds of what was considered the *minimum* winter force only a few years ago. It is not without interest also to note the fact that the *maximum* force in any month in the last three years has been below the normal winter force prior to 1930. This reduction in employees has been all the more severe by reason of the shortened weeks and days that have been put into effect on most roads to distribute as widely as possible the work that was available.

Expenditures for Maintenance of Way and Structures

1911†	$348,004,080	1922	728,663,534
1912†	348,470,704	1923	813,688,760
1913†	406,042,529	1924	792,678,023
1914†	403,682,593	1925	816,443,205
1915†	364,004,178	1926	866,819,365
1916†	404,514,144	1927	868,581,432
1916	421,775,812	1928	837,905,747
1917	442,109,862	1929	855,354,867
1918	649,794,953	1930	705,470,940
1919	772,186,045	1931	530,612,890
1920	1,032,540,381	1932	351,179,041
1921	756,413,690	1933*	325,000,000

† year ending June 30, all others calendar year
* last two months estimated

The Condition of the Properties

In view of this marked decline in expenditures and in labor employed, it is pertinent to review the condition of the properties. With an accumulated decrease in expenditures for roadway alone up to the end of 1933, as compared with the 1925-1929 average, of more than one billion dollars, with a corresponding decrease in expenditures for the upkeep of structures approximating $120,000,000, and with water service maintenance reduced $12,000,000 to $15,000,000, it is evident that, even after making full allowance for the decreased traffic, there is a deficiency in upkeep equalling at least a full year's normal expenditures. In many details this deficiency is far greater, for attention has been concentrated on those activities essential to safety of travel, to the large or complete neglect of other tasks that, while essential eventually, can be postponed for a time without grave consequences.

That the properties have been able to stand up as well as they have in the face of such reductions in expenditures reflects credit on those who have directed activities during the last few years. Equally, however, it vindicates the policy followed prior to 1930 of building a reserve of strength into a property when earnings permit, in order that it may be enabled to carry through the next period of decreased earnings—for such periods come at intervals, whether we will or not. That the railways have been able to come through this long period of starvation with their properties in as good condition as they are today is due to the liberal reserve strength that was plowed into them in the prosperous years of 1923-1929. With this lesson so clearly before them, maintenance officers will unquestionably utilize the first opportunity to bring their roadway and structures back to their 1929 condition.

Yet retrenchment such as we have been witnessing cannot long continue. This is evident from a study of the renewals of those basic units of the track structure—rail and ties. Prior to 1929 the roads normally purchased and installed in replacements approximately 2,000,000 tons of rails a year. In 1930 the renewals declined to 1,517,000 tons; in 1931 to 984,900 tons; in 1932 to 394,007 tons and in 1933 to probably 225,000 tons. Even after making full allowance for decreases in traffic, it is estimated that the total present deficiency in rail replacements totals 3,400,000 tons. Similarly, it is estimated that there are today in track more than 75 million ties that would, under more normal conditions, have been renewed. The same conditions are found throughout maintenance—more pronounced in many activities such as painting where practically nothing has been done for four years.

A Change in the Trend

Of more immediate interest than the continued decrease in expenditures that has been effected during the last four years is the change in this trend that occurred last summer. The maximum decline in traffic, as compared with the corresponding period of the preceding year, occurred in the summer of 1932. Since that time, the gap, measured in number of cars loaded, has been steadily narrowing until in the week ending May 13 the number of cars loaded exceeded, for the first time since October 1929, the number loaded in the same week of the year previous. Since that time the loadings for each week have shown an increase, as compared with the corresponding week of 1932, with the result that the total number of cars loaded in 1933 exceeded those loaded in 1932 by approximately 750,000.

Trend of Maintenance Expenditures by Month

	1931 (*000 omitted*)	1932	Per Cent Change	1932 (*000 omitted*)	1933	Per Cent Change
Jan.	$43,737	$29,979	−31	$29,979	$22,655	−25
Feb.	41,392	28,466	−30	28,466	21,596	−25
Mar.	46,734	30,760	−34	30,760	22,592	−28
Apr.	51,441	32,505	−37	32,505	24,440	−25
May	52,589	33,951	−36	33,951	27,323	−20
June	51,962	32,713	−37	32,713	28,805	−12
July	50,075	29,449	−41	29,449	30,401	+ 2
Aug.	47,099	28,990	−38	28,990	32,769	+10
Sept.	43,256	28,059	−35	28,059	31,597	+11
Oct.	42,004	28,972	−30	28,972	30,961	+ 7
Nov.	35,233	26,233	−26			
Dec.	30,353	21,365	−30			

Net railway operating income showed a corresponding increase and this was in turn reflected in increased expenditures for maintenance of way. This is shown in the accompanying comparison of expenditures month by month with those of the same period for the year previous.

As was to be expected, the railways directed the first additional money that became available for maintenance to the correction of a myriad of smaller details that pressed for attention. It was not until the closing weeks of the year that any real consideration was given to the making good of the major deficiencies and even this was confined largely to rail, the purchase of which was

stimulated by the federal administration, with the result that as the year closed approximately a half-million tons had either been ordered or the financing definitely arranged for, while a large additional tonnage was under negotiation. This rail, which, with fastenings, will considerably exceed a million tons, constitutes a large order; yet it is still less than half an average year's purchases prior to 1929 and will make good less than a third of the deferred renewals that have accumulated.

It is to be expected that these orders for rails will be followed by others for other equally necessary materials. Already loans have been approved from the Federal Public Works fund for the purchase of a large number of ties by one western road and for the repair of certain large bridges by another road. Other loans are being announced daily, applications having been filed for sums sufficient to more than exhaust the entire $400,000,000 set aside for the railways. A large part of this money will go for roadway and structures work—the remainder for equipment.

Work Equipment

An interesting development of the year has been a crystallization of opinion regarding work equipment and other measures to promote efficiency. In the earlier stages of the present period of widespread unemployment there were some who felt that this condition called for a return to hand methods. Further consideration, however, led to an appreciation of the fact that the amount of employment is not now fixed by the volume of work to be done but by the amount of money available, and that to do each job in the most efficient manner possible permits the money thus saved to be applied to another job, creating employment to offset that curtailed on the first job and increasing the total amount of necessary work which it is possible to do with the money available. As a result, the policy of using mechanical equipment has weathered the period of unemployment and has gained increased acceptance in a number of quarters.

As would be expected in a period like that through which we have been passing, when sufficient money has not been available to make current repairs, expenditures for the improvement of the properties have been practically nonexistent. With facilities far in excess of present demands, there has been little incentive to add to them in anticipation of future increases in business, even if money were available. As a result, the program of additions to and improvement of the properties initiated in 1923 and in which more than $7,500,000,000 of new money was expended prior to 1931, has been suspended. This program, which was the most extensive ever undertaken by the roads, involved the spending of approximately $850,000,000 a year, nearly two-thirds of which went for roadway improvements, over and above all expenditures for upkeep and repair. These expenditures have been productive of such large economies that it is to be expected that they will be resumed as soon as funds again become available and industrial recovery progresses to the point where further expenditures for other than immediate necessities are again warranted.

The completeness of the cessation of construction activities is shown by the fact that only 24 miles of new lines were completed in the United States last year, a figure without parallel in the history of American railroads. This compares with 163 miles in 1932, with 748 miles in 1931 and with an average of 4,796 miles in the decade from 1900 to 1909 inclusive and with 6,026 miles in the peak year of 1902. In Canada, no new mileage was built last year.

Another indication of the trend of the times is afforded by the mileage of lines abandoned. During the last year roads have been especially active in taking the necessary steps preliminary to the cessation of operations on lines that are no longer profitable. By this action they are divesting themselves of lines that fail to pay their way and eliminating the drain on the remainder of the properties. In the United States, the mileage abandoned totaled 1842 miles, the largest for any year since 1917 when figures were first compiled. In Canada, 82 miles of line were taken up.

The New Year

As one turns from the year that has just closed to the year that is opening, the outlook is more cheerful. The change in trend that was noted last summer is gaining momentum. Improvement in business activity is in evidence, not alone in this country but in other countries as well, indicating that fundamental and far reaching forces of recovery are at work. In addition, the effects of the various measures in the national program, notably the public works activities, will become increasingly beneficial as we approach the more active season for construction in the spring.

Coming closer home, the loans that are being made to railways are enabling them to initiate needed work, thereby not only contributing to industrial recovery through the production of materials entering into these improvements, but putting the railways themselves in shape to handle efficiently the business of the nation when it returns. As each of these industries increases its activities, more traffic will be turned over to the railways, increasing their earnings to the point where they may again finance their own requirements.

Another development of the year which holds much of promise for the railroads is the comprehensive survey of transportation that is being made by Federal Co-ordinator Joseph B. Eastman, preliminary to the drafting of legislation to place the railways on a more sound basis, especially with reference to highway, air and waterway competition. It is expected that the recommendations for this legislation will be beneficial to the railway industry.

All in all, therefore, the outlook confronting the railways is now considerably brighter than it was a year ago, or, in fact, than it has been for three or four years. While there are still many problems to be cleared up before it can properly be said that the depression has lifted, there are many evidences that economic and political forces are working to bring about a recovery of industrial activity. Developments of the last few weeks have shown that as fast as this recovery becomes evident, the railways will undertake the restoration of their properties to that condition essential for most economical operation and, following this, will resume that program of rehabilitation and modernization that will enable them to compete more effectively with the newer agencies of transportation. 1933 was a year of discouragement. 1934 bears promise of being a year of recovery.

Drainage System Overcomes Serious Slides

Embankment on the Pennsylvania near Marshall, Ill., was source of serious concern until subsurface pipes removed water that was the cause of the trouble

THE success attained by the Pennsylvania in overcoming serious slides in an embankment near Marshall, Ill., affords an illuminating demonstration of the effectiveness of subsurface drainage that has been designed specifically to meet the local conditions, as determined by a complete subsurface survey. A measure of the seriousness of the conditions existing at this point is afforded by the fact that at one time last fall the toe of the slide was advancing at the rate of four feet a day and that it was deemed necessary to impose a five-mile slow order on the track over this embankment, which is on the main line from New York and Indianapolis to St. Louis on which speeds of 70 m.p.h. are by no means unusual. Yet on May 13, some time after the completion of the drainage system, a rainfall of 1.65 in. developed no evidence of instability of the fill, although it resulted in the discharge from the drainage outlets of 23,732 gal. of water in a period of 24 hr.

The Embankment Was New

The embankment in question comprises the west approach to the crossing of Big Creek and was constructed in 1928 as a part of a local relocation incident to the construction of a new three-span deck girder bridge across the creek. This fill lies on a steep slope so that its height, which is about 65 ft. behind the west bridge abutment, runs out approximately 400 ft. to the west. The support for the fill comprises limestone in horizontal beds that are stepped off approximately in conformity with the ground slope and are covered with from one to five feet of loosely consolidated shale over which there is from two to four feet of soil. The embankment material was largely clay.

View of a Slippage Plane Discovered in the Pit at Project "C," Illustrating the Polishing Effect of the Sliding Movement Under Pressure

This embankment began to develop signs of instability soon after it was completed and in the latter part of 1929 a preliminary investigation was made to determine the cause of the trouble, but as the slides were all on the south side where the extra width of roadbed had been provided for the second track which had not been placed, it was decided to await further developments before undertaking extensive corrective measures. In the meantime loss of embankment section as a result of the sloughing of the slope was made up by dumping cinders, and for a while conditions were such as to occasion no alarm. However, in the fall of 1932 the sliding assumed dangerous proportions. The toe of the slope moved out so rapidly that in a short time it had gone 300 ft. beyond the original toe line, in addition to an eastward movement at the head of the embankment that threatened to block the creek channel. Accordingly, a thorough investigation of the causes of the sliding was undertaken.

This study developed evidence of an appreciable volume of seepage from the shale and limestone strata, in addition to a considerable flow from springs or surface water that entered the top soil in the higher ground to the west and followed the natural grade of the rock, descending to the east. It was concluded that the water from these sources was the primary cause of the slides. The original movement was evidently due to the development of a plane of sliding in the shale, which becomes exceedingly slick when wet. This was clearly demonstrated in the excavations made subsequently, when a number of slippage planes, like those shown in the illustrations, were uncovered. An important contributing factor was the effect of water on the clay fill, which reduces it to a semi-fluid of almost no supporting power.

Conditions Aggravated by Water Pockets

However, the conditions were greatly aggravated by water pockets that were formed and grew in size and number with the progress of the slides. The movement of the fill was characterized by the customary sloughing of the top of the embankment, with the formation of a steep slope that gradually flattened out toward the advancing toe. However, this slope was far from uniform; there were numerous bulges and cracks, and along the toe the material was rolled up to form an irregular ridge. As the embankment was filled out from time to time with cinders, the south slope was eventually covered with a heavy blanket of porous material supported on an impervious base, which, because of its irregular surface, contained many depressions that held any water that filtered down through the cinders. This condition naturally resulted in a further softening of the clay and an aggravation of the slides.

Predicated on these conclusions as to the sources of the instability of the embankment, steps were taken to de-

velop an effective subsurface drainage system that was designed to meet two distinct objectives: (1) To intercept the flow of water down the original ground slope and in the upper rock strata, and (2) to drain the various water pockets. A careful survey of the fill by means of numerous borings indicated that both objectives could best be gained by carrying out four individual projects that were more or less independent of each other, although all of them possessed the same essential elements, namely, perforated corrugated iron pipes driven into the fill in various positions and at different elevations and slopes, and assembled at catch basins provided with suitable discharge lines.

The primary unit, known as Project A, comprised 180 ft. of 36-in. pipe that was driven in a northeasterly direction from the bottom of a pit excavated just beyond the toe of the slide. This pipe was designed primarily to intercept the subsurface flow from the northwest and was advanced at such an elevation that its lower half was in the shale or hardpan bed, thus placing it in the plane of maximum flow and providing reasonable assurance against movement by reason of any shifting of the superimposed fill. This pipe was placed in part by jacking it from a pit at the lower or outlet end while the material in front of the advancing end was removed by men working inside the open end. When the friction on the outside of the pipe attained a magnitude that would not permit of further jacking, this process was discontinued and the rest of the pipe was constructed of nestable half pipe erected inside of a tunnel heading.

Serves as Receiving Line

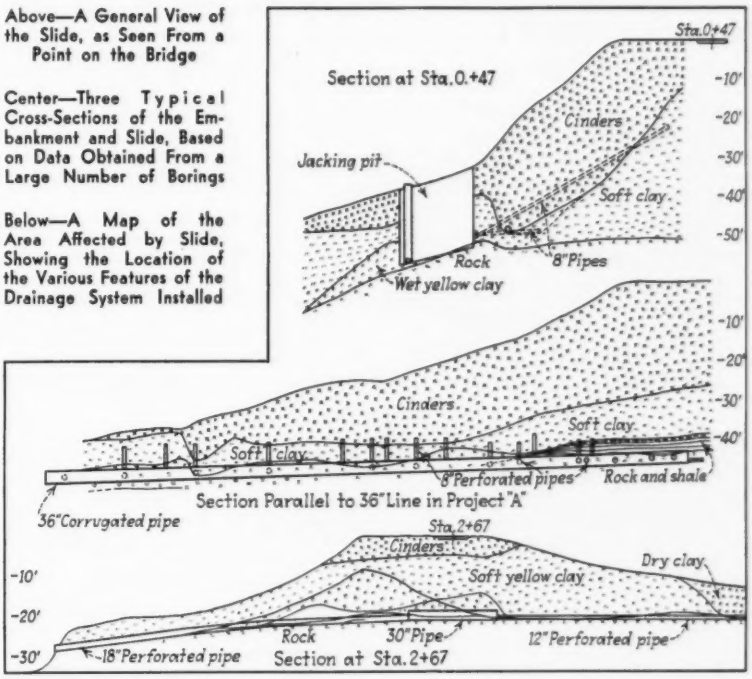
The 36-in. pipe also serves as the main or receiving line for a large number of 8-in. pipes that were jacked into the surrounding fill to the right and left as well as directly upward for the purpose of draining water pockets located within 25 ft. of the 36-in. line, in addition to several large pockets that were encountered directly in driving the large pipe itself. The lower end of this pipe terminates in a brick walled man-hole, from which a 12-in. pipe was extended downhill to the south to provide an outlet for the water.

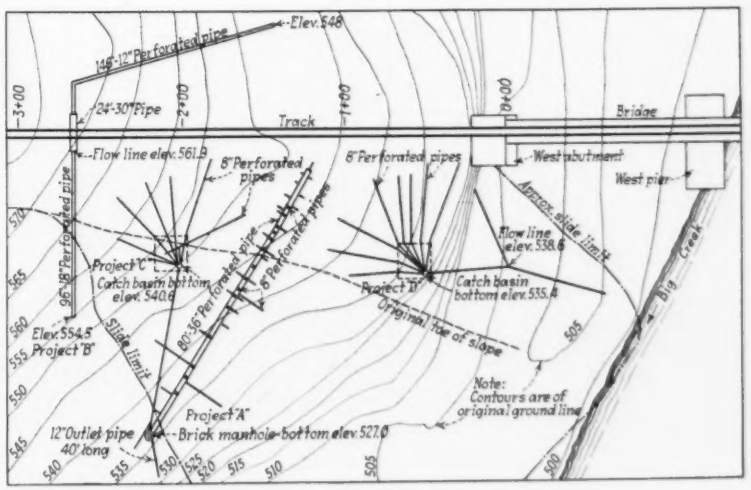
The effectiveness of Project A is evidenced by the fact that 190,000 gal. of water were discharged from the 36-in. pipe in 50 days, much of it during the time that pipe was being advanced into the fill. This discharge was greatly accelerated on three different occasions, when water pockets were encountered—in one case amounting to

Above—A General View of the Slide, as Seen From a Point on the Bridge

Center—Three Typical Cross-Sections of the Embankment and Slide, Based on Data Obtained From a Large Number of Borings

Below—A Map of the Area Affected by Slide, Showing the Location of the Various Features of the Drainage System Installed



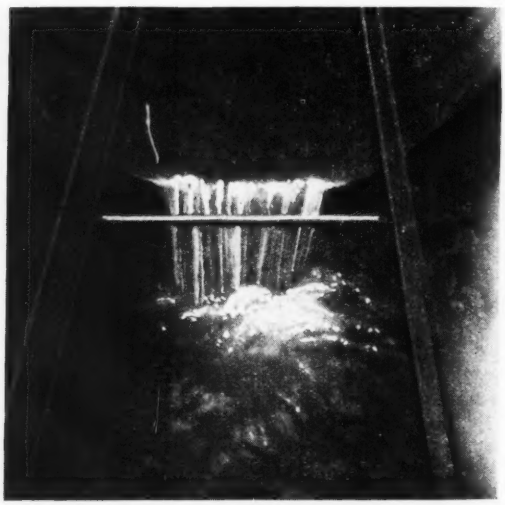


26,000 gal. in less than five hours, compared to an average flow of 3,800 gal. a day for the 50 days.

Project B, near the west end of the fill was designed primarily to intercept the subsurface flow from the west. It comprises a 24-ft. length of 30-in. pipe placed under the track by tunneling and jacking, with its invert 21 ft. below base of rail, and connected at each end to lines of 18 in. pipe placed in open trench. These pipes were extended into the 30-in. pipe, and the unoccupied portion of the open ends of the larger pipe were bricked up. The outflow pipe on the south is 96 ft. long and the one on the north, which turns off to the east, is 146 ft. long.

Two Systems Drain Water Pockets

Projects C and D are similar, each consisting of radiating lines of 8 in. pipe terminating at their common centers in a corrugated iron Armco catch basin, from which another pipe is carried downhill to a suitable point of discharge. The discharge line from Project C is connected to the manhole of Project A, while the outlet from Project D terminates in the creek. In the case of both projects C and D, the power jacking of the various lines was conducted from pits 20 ft. square that averaged 11



The Discharge From the 36-in. Main of Line "A," One Hour After a Large Water Pocket Was Tapped During Its Construction

and 20 ft. in depth, respectively. With the jacking machines employed, no particular difficulty attended this work, it being possible to drive the pipe with a minimum of variation from the intended vertical and horizontal angles. In fact, more time and effort were not infrequently expended in the borings necessary to determine exactly where the pipes should be placed. The objective in Project C was in part that of an intercepting drain, although some of the branches serve also to discharge water from pockets. In Project D, on the other hand, all of the branch pipes serve as water-pocket drains.

Sliding Is Stopped

For some time following the completion of the drainage system, the embankment was subject to such settlement as attended the solidification which naturally followed the release of a large volume of water. However, the sliding was effectively stopped and even during the unusually heavy rains of the past spring there was no evidence of a lack of stability.

The detailed investigation of the unstable fill near Marshall and the planning and constructing of the drainage system was carried out by the Drainage Engineering Company, a subsidiary of the Ingot Iron Railway Products Company, Middletown, Ohio. All of the pipe used was perforated corrugated Armco iron. The work was done subject to the approval of Porter Allen, chief engineer maintenance of way, of the Western region of the Pennsylvania, and under the field supervision of N. M. Lawrence, division enginer on the St. Louis division.

Ties Inserted in 1932 Show Further Decrease

IN 1932 the Class I railroads of the United States installed 39,175,741 wood crossties in previously constructed tracks, a decrease of 12,310,886 ties, or 24 per cent, as compared with the number installed in the previous year, according to figures issued by the Bureau of Railway Economics. The accompanying table lists the total number of crossties inserted, for each year from 1920 to 1932, inclusive, and also shows separately the untreated and treated ties, and ties other than wood inserted, as well as the number of board feet of switch and bridge ties that have been installed.

Ties Laid in Previously Constructed Tracks*

	Untreated Ties No.	Treated Ties No.	Other Than Wood Ties No.	Total, All Cross Ties* No.	Switch and Bridge Ties Ft. b.m.
1920	48,631,543	37,792,431	154,378	86,829,307	246,195,929
1921	49,238,665	36,071,989	536,188	86,521,556	256,287,730
1922	45,212,085	40,629,943	554,250	86,641,834	258,186,478
1923	42,072,140	41,655,616	447,002	84,434,985	277,615,107
1924	38,317,244	44,489,687	3,360	83,073,059	291,288,388
1925	32,623,486	50,089,966	3,222	82,716,674	282,629,608
1926	25,184,662	55,557,706	3,141	80,745,509	275,971,880
1927	21,240,053	57,082,993	17,136	78,340,182	259,996,468
1928	18,191,677	59,157,540	21,724	77,370,941	269,149,270
1929	15,614,898	59,047,380	17,097	74,679,375	250,062,751
1930	13,618,718	49,720,080	15,030	63,353,828	235,314,604
1931	11,658,836	39,827,791	15,032	51,501,659	188,594,522
1932	9,740,686	29,435,055	14,732	39,190,473	140,565,691

*From 1920-24, inclusive, these figures include second-hand unclassified wood ties in the following amounts: 1920, 250,955; 1921, 674,714; 1922, 245,556; 1923, 260,227; and 1924, 262,768.

Switch and Bridge Ties Decline 25.4 Per Cent

Switch and bridge ties placed in existing tracks in 1932 amounted to 140,565,691, ft.b.m., a reduction of 48,028,831 ft.b.m., or 25.4 per cent, below the same figure for 1931. The number of ties other than wood, however, remained practically constant, 14,732 having been installed in 1932 as compared with 15,032 in the previous year. This classification represented only 0.04 per cent of the total number of ties installed.

While the number of treated crossties declined 26 per cent as compared with 1932, the number of untreated ties decreased only 16.5 per cent. As a result, the proportion of untreated crossties installed increased from 22.6 per cent of the total in 1931 to 24.8 per cent in 1932.

These figures should not be confused with the statistics covering the crossties treated in 1932, prepared by the forest service of the United States Department of Agriculture in co-operation with the American Wood-Preservers' Association and published in abstract in *Railway Engineering and Maintenance* for October. While the latter figures showed that 35,045,483 crossties were treated in 1932, the accompanying table shows that only 29,435,055 treated ties were installed in existing tracks during the year, the discrepancy indicating that a considerable portion of the treated ties was carried over. However, a part of the difference may be accounted for by the ties inserted in new tracks during the year.

View Showing the New Platform Surface

Hand Mixing the Materials

Long Platforms Repaved Under Difficulties

Thin layer of asphalt mastic is laid over old paving without interfering with passenger traffic

Applying the Body Course

Applying the Top Dressing

DURING the last summer, the New York Central carried out a job of repaving two long passenger station platforms, which is of interest because of the character of the platforms repaved, and the large number of train movements and heavy passenger traffic which surrounded the work. The platforms were at the 125th Street station in New York, and are located on a structural steel viaduct about 26 feet above the street level. They were formerly paved with a road asphalt for the greater part of their length, which had worn and flattened in years of heavy service, causing some depressions in which water stood during rainy weather, in spite of the fact that both platforms are covered by shed-type roofs. In the repaving work, a smooth crowned surface was restored, using a specially compounded asphalt mastic, mixed with sand and Portland cement, which was applied directly over the old material.

The work, which was completed in about two months, was done while approximately 475 trains made the station stop daily, discharging and receiving thousands of passengers. This traffic interfered with the progress of the work somewhat, but by undertaking the paving in relatively short sections, and with the co-operation of the train crews in stopping trains so that car doors cleared the work, the project caused practically no inconvenience to passengers.

Old Asphalt Paving Had Long Life

The 125th Street station was constructed in 1897, at the time the New York Central elevated its tracks on a structural steel viaduct through this section of the city. The platforms, one 909 ft. long and 16 ft. 9 in. wide, and the other 832 ft. long and of the same width, each serve two tracks. Originally, the end sections of both platforms were provided with plank decks which were not covered, but the main body of both platforms, through a distance of approximately 500 ft., was constructed with an asphalt surface over one-inch creosoted plank. This surface was from 2 in. to 2½ in. thick at the center of the platforms and was sloped to both edges, with sufficient crown for drainage.

A common road asphalt was used which, apparently, was not well suited for paving on exposed platforms, because it cracked so badly during the first few winters that it became desirable to remove it completely in 1903. At this time both platforms were repaved with an asphalt that was softer and less affected by changes in temperature. This latter paving remained in service until the last summer and proved quite satisfactory, except that

during recent years, under continued heavy foot and baggage traffic, the crown had practically disappeared and depressions began to form. During its life of approximately 30 years the paving had been disturbed only when, about 10 years ago, a strip about 5 ft. wide was taken up along the inner side of each platform to permit the repair of certain of the viaduct girders. With further work contemplated on the steelwork at some future time, the base planking was restored, but was not repaved with asphalt. For the same reason, the repaving in the recent work was not carried over the planked strip on either platform. The planking has been well maintained and offers none of the disadvantages of the old paving.

Material Was Carefully Selected

The selection of the material best adapted for resurfacing the platforms involved a number of considerations. In the first place there was the element of first cost. It was required also that the material used retain a degree of flexibility sufficient to withstand, without cracking or disintegration, the vibration and expansion and contraction within the viaduct structure. At the same time it was essential that it become hard enough to withstand the heavy foot and baggage truck traffic to which it would be subjected, without becoming brittle with the low temperatures of winter or too soft when exposed to the direct rays of the sun in the summer. Added to these were the requirements that the material bond securely with the old asphalt surface, that it be capable of being worked down to a feather edge, and that it set up readily to permit the restoring of the repaired areas to service as quickly as possible. The material selected to meet these requirements was a fibrated asphalt flooring mastic of the water emulsion type, especially compounded for mixing with water, sand and Portland cement in the proper proportions to bring about the degree of floor hardness desired.

In carrying out the resurfacing work, which was done generally in sections about 30 ft. long and 11 ft. 7 in. wide, the full paved width of the platforms, the first operations were to sweep the old surface clean and then coat it with a primer. The primer, which was applied with a broom, was a thin coating of emulsified asphalt, which bonded readily with the old paving.

Almost as soon as the area being worked had been primed, the part first coated was ready to receive the paving material. This material was mixed in the proportion of 15 gal. of the fibrated asphalt mastic, 4 cu. ft. of sand, 1 cu. ft. of cement and only enough water to produce a mixture which could be worked and trowelled readily. In preparing the mixture, which was done with shovels directly on the old platform surface, the sand and cement were mixed dry and were then added to the diluted asphalt. The mixture was applied with ordinary mason's trowels and floats.

After this body material had set up slightly, which required an hour or two, a thin final wearing course, about ⅛ in. thick, was trowelled over it to a final surface, working from the sides of the paved section, or above it on a plank supported on blocking at its ends. To give the surface a slightly rough finish, sand was screened over it while still soft, surplus sand being swept off after the paving had set up. While not considered absolutely essential, the paving was rolled with a 200-lb. hand roller 12 to 14 hours after it was laid, the thought being that the rolling increased the density of the flooring material.

Throughout both platforms, the new paving material was laid from 1½ to 2 in. or more thick at the center, varying with the depressions in the old surface, and was carried out to a feather edge along both sides. Expansion joints were provided continuously across the platform at intervals of about 54 ft., in each case directly over the transverse girders of the viaduct structure where cracks had developed in the old paving.

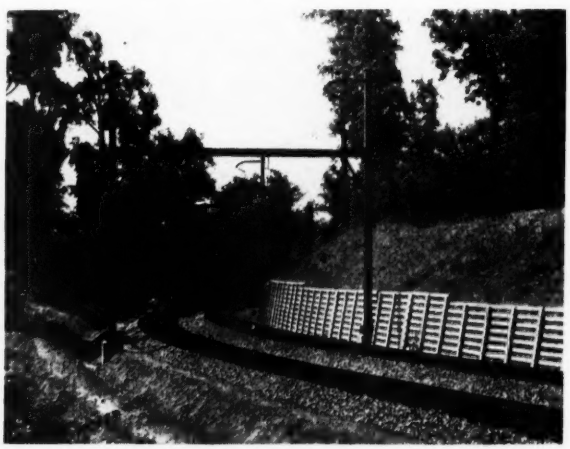
The expansion joints were continued down through the old paving by cutting out a one-inch strip of the old material just prior to applying the new top course, and then filling it with a relatively soft mixture of the asphalt mastic. As the new top course was laid, a ½-in. board was set up in the joint to form a joint opening in the new surface material. Later, this was withdrawn and the opening was filled with the softer mastic mixture. This same softer mastic was used directly around the bases of the shed columns to minimize the transmission of vibration from the columns to the paving, which experience showed had tended to crack the harder paving material. At the joints between the areas completed on successive days, unless these coincided with the expansion joints over the main cross girders, the newer material was merely lapped over and sealed to a beveled edge left on the work of the previous day.

Flooring Hardened Over Night

Throughout the entire work of repairing the platforms, only about 60 lineal ft. of a platform was taken out of service at a time, which, with careful stopping of trains, avoided the necessity of blocking any of the car doors. Furthermore, the five-foot strip of continuous planking along the inner side of both platforms, afforded free passage around the sections being repaved. Temporary timber barricades kept passengers away from the work and off the newly paved areas.

Ordinarily, a new 30-ft. section of paving was undertaken each day and was fully completed, except for rolling, before quitting time in the evening. The rolling of each section was generally done the day following that on which it was laid, usually between 7 and 8 a.m. By noon of the day following the laying of the pavement the repaved sections were generally sufficiently hard for foot traffic, although removal of the barricades was delayed a few hours in some cases where no inconvenience was occasioned to passengers, or where depressions in the old surface required increased thickness in the new layer.

The work, which was done by a force of 10 men, including a foreman and watchman, was carried out under the supervision of E. R. Tattershall, supervisor of bridges and buildings. The paving material used, which is known as Collins' Fibrated Floor Mastic, was furnished by the Maloney Oil & Manufacturing Company.



On the Electrified Germantown and Chestnut Hill Line of the Reading

The Menace of Bridge Fires*

Extra precautions are necessary because of the limited opportunity to discover the presence of a fire soon after it has started

By W. F. STEFFENS

Fire Protection Engineer, New York Central

Bridge Fires Have Resulted From a Variety of Causes

IN bridges with decks of non-combustible construction the fire hazard from any source is practically negligible. On the other hand, if the construction is of timber, either treated or untreated, the hazard of fire is always present. For bridges carrying railroad traffic and designed with wooden ties, with or without the usual openings between adjacent ties, the possibility for fire communication from external sources must be kept constantly in view. Incipient fire in individual ties may not interrupt continuity of traffic, but if such a fire should grow to greater proportions, as is frequently the case during high winds and when the nature of the deck material is such as to increase the intensity of the fire more quickly than that of ordinary timber, not only may traffic be temporarily delayed but the heat may be sufficiently intense to injure the supporting members, whether of steel or of wood, to such extent that all traffic must cease until the burned or injured parts have been replaced. Steel is not "burned" at the temperatures attained in ordinary fires, but when it is heated to annealing temperatures, the physical characteristics of the material may be radically altered, and the fabricated shapes become so distorted as to be incapable of serving the function for which they were designed.

Causes of Fires

Mention has been made of external sources of ignition, and these can be detailed as lighted matches and smoking materials carelessly discarded, hot coals from locomotive ash pans, lighted fusees dropped by train crews, and grass fires under or adjacent to the pile bents of a wooden trestle. When bridges are being constructed or repaired, hot rivets and torches have been known to cause ignition.

The susceptibility of timber to ignition from external sources varies from a minimum in sound, hard specimens to a maximum in the softer varieties, especially when the surfaces have been opened by seasoning checks, in which moisture has collected and produced conditions favorable for decay. This immediately affords argument for some type of preservative treatment that will minimize the possibility for decay. It is suggested, also, that the hazard of fire in badly checked ties and timbers of bridge decks will be decreased if they are coated with some form of asphaltic cement. If this material has a high flash point it will serve also as a protection against the initiation of combustion from any of the sources previously outlined.

The problem of supplying first-aid means of extinguishing fires on bridges for the protection of the decks is quite different from that of protecting property in terminals and railroad yards, because most bridges are in isolated locations. Consequently, the possibility of detecting a fire in the incipient stages, which depends largely on the density of the traffic over the structure or its proximity to occupied buildings, is rather unfavorable. For short span bridges, water barrels and pails are recognized as perhaps the most efficient protection immediately available. In latitudes of low temperatures the barrel is filled with a calcium chloride solution to prevent freezing. For an incipient fire this form of extinguishment is most efficient. For structures of greater length it is customary to provide supports for the water barrels at intervals of about 150 ft.

For very long structures, standpipes with hose outlets at intervals have been considered essential. These lines are normally dry, and are furnished with water under pressure from the ends of the line, either from municipal or private supplies under pump pressure, or from the pumpers of the local fire department. One installation of this nature, on a bridge over a river between two states, is one-half mile long and can be served by pumpers from one or both cities at the ends of the line.

Use of Fire Cars

A more mobile form of protection for bridges is a fire car, consisting of a pumping unit placed between two water-supply tanks on a flat car, and possibly with an attending car with additional water supply. Steam for the operation of the pump is furnished from the locomotive. One important item, however, not usually included in the equipment of a fire car, must be available if, as in most cases, the fire crawls to the under surfaces of the ties. On account of the limited space between adjacent ties, water from hose streams served through straight nozzles cannot reach this zone of fire. Bent pipes with whirling spray nozzles, or with special tips to serve a fan-shaped stream, are almost imperative to combat a fire at this otherwise inaccessible point successfully. The incomplete extinguishment of a fire in a bridge deck at the lower surfaces of the ties may mean that in a high wind the fire will again crawl to the sides and top surfaces of the ties, and not only increase the fire damage to

(Continued on page 26)

*Abstracted from a paper read before the Railway Fire Protection Association at Chicago.

Orders for Rails Will Soon Reach 500,000 Tons

WITH the details of the procedure worked out, real progress is now being made in the granting of federal loans to the railways for the purchase of rails and track fastenings, as well as cars and locomotives, and for various projects for the general maintenance of roadway and structures and of equipment. This is illustrated in the applications for loans in connection with the allotment of $51,000,000 for the purchase of rails and fastenings. Thus, the Chicago, Milwaukee, St. Paul & Pacific made application for a loan, announced on November 8, of $1,818,750, to be used for the purchase of 50,000 tons of rails, but owing to the many problems that had to be met, it was not until December 18 that the Interstate Commerce Commission granted approval. However, only four days later similar approval was accorded the applications of three other roads and again on December 28, five more roads were granted loans for the same purpose. These include $3,461,914 to the Chicago & North Western for 65,000 tons of rail and 18,000 tons of fastenings; $251,300 to the Chicago & Eastern Illinois for 4,000 tons of rail, as well as fastenings; $47,000 to the Pittsburgh & West Virginia for 1,000 tons of rail and also fastenings, and $265,000 to the Kansas, Oklahoma & Gulf, for 5200 tons of rail. Besides these, blanket loans for a variety of items, including 40,000 tons of rail, were made to the Southern Pacific; the Illinois Central, 21,600 tons; the Baltimore & Ohio, 35,000 tons; and the Wabash, 10,000 tons.

These nine loans will result in the purchase of about 232,000 tons of rail. But in the mean time several other roads have placed orders for a large tonnage of rail to be financed from corporate funds. Including the Norfolk & Western and the Chicago, Burlington & Quincy, whose orders for 10,000 tons and 25,000 tons, respectively, were reported in the December issue, 11 railways have placed orders to date aggregating 182,557 tons. Adding to the above figures, the 25,000 tons listed in the application for a loan filed by the New York, New Haven & Hartford, as well as the 25,000 tons which the federal court has authorized the Missouri Pacific to buy, and the orders of two other railways, aggregating 21,000 some tons, that are now pending, it is evident that the rails already purchased or about to be purchased by only 24 roads, including 3 relatively small properties, will total about 485,000 tons.

Many Considerations Involved

An idea of the work that has been involved in reviewing the applications of the railways for loans to finance the purchase of rail is evident in the report of the Interstate Commerce Commission on the allotment made to the Milwaukee. This embodies a statement outlining its reasons for affirmative action, which is reproduced in part below:

The amount of new rail purchased for replacements is generally governed, during normal times, by the need for renewals, and is influenced by the amount of money available for that purpose. The applicant's statement of renewals indicates a need of additional rail. Rail wear, generally speaking, is governed by the amount of traffic passing over it, being greater or less for the same amount of traffic in different localities according to the amount of curvature and grade. For the same road or system, traffic conditions over a period of years may be accepted as a fair index of rail requirements. While the figures given for the years 1930 to 1932, inclusive, show a shortage of 85,500 tons in the applicant's normal replacements, there has been a decrease of approximately 26 per cent in traffic for these years. If the carrier's requirements be estimated on this basis, the shortage in rail replacements would be approximately 45,000 tons. Since in periods of depression railroad tracks usually are undermaintained, which has a detrimental effect on the rail, and that appears now to be the situation in the case of the applicant, its estimate of 50,000 tons for its present needs appears to be reasonable.

Since the publication of the December, 1933, issue, orders for rail have been placed by nine railroads independently of any financial assistance from the government. The requirements of the Pennsylvania for 100,000 tons, referred to in that issue, have been divided among four companies as follows:

Bethlehem Steel Company	44,000 tons
Carnegie Steel Company	42,000 tons
Illinois Steel Company	8,000 tons
Inland Steel Company	6,000 tons

These tonnages were supplemented by an order for 350 tons of girder rails placed with first named company. Other orders placed were as follows:

Lehigh & New England

Bethlehem Steel Company	3,014 tons 100-lb. head-free R. E.
Bethlehem Steel Company	183 tons 100-lb. R. B.

Northern Pacific

Inland Steel Company	2,000 tons
Illinois Steel Company	4,000 tons
Colorado Fuel & Iron Company	500 tons

Clinchfield

Tennessee Coal Iron & Railroad Company	500 tons

Richmond Fredericksburg & Potomac

Bethlehem Steel Company	500 tons

Western Maryland

Carnegie Steel Company	2,000 tons 90-lb. A. S. C. E.

Delaware Lackawanna & Western

Lackawanna Steel Company	11,000 tons 131-lb.
Carnegie Steel Company	1,000 tons 131-lb.

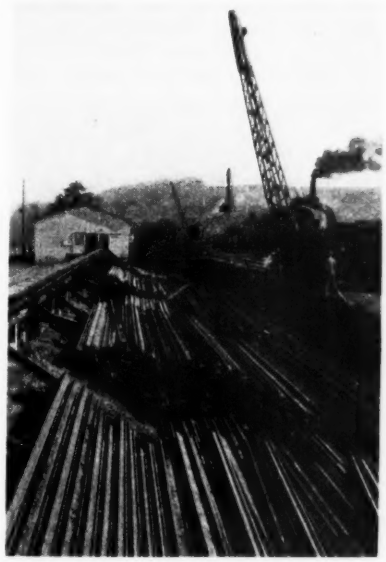
In addition to the above, the Delaware & Hudson has ordered 5,000 tons of 131-lb. rail, and the Louisville & Nashville, 17,500 tons of 100-lb. rail. The Missouri Pacific is planning to purchase 12,150 tons of 112-lb. rail and 12,850 tons of 90-lb. rail, together with 1,410,800 tie plates and 634,200 rail anchors.

Some of the loans previously listed, provide financial assistance for other roadway purposes as well as for rails and fastenings. Thus, the Illinois Central is to receive $9,300,000, of which $1,437,145 is for rail and fastenings, tie renewals and changes in signals, the requirement for rails being stated as 123 miles of 112-lb. section (21,600 tons). Another item is for $1,037,000 to be spent in the renewal of the Big Clifty viaduct, in work on the Ohio River bridge at Cairo, Ill., and in relining a tunnel near Reevesville, Ill. The loan to the Southern Pacific, in addition to financing the purchase of 40,000 tons of rail, and fastenings, will provide for the renewal of 1,820,000 ties. Besides these loans, the Boston & Maine has received approval for a loan of $5,500,000 which includes $2,215,000 for use in the general upkeep of roadway and structures.

Supplementing the loans for rail and other purposes incident to the maintenance of roadway and structures, applications for loans have been filed by the New York New Haven & Hartford for $1,350,000 to cover the purchase of 25,000 tons of rail and 10,000 tons of fastenings, and by the Waco, Beaumont, Trinity & Sabine for $5,000,000, of which $1,486,000 is for the rehabilitation of 90 miles of line.

The loans made to the railroads for the purchase of rails and fastenings represent only a part of the allotments to the roads by the P. W. A., which now total well over $200,000,000. The largest single item is the allotment of $77,000,000 to the Pennsylvania for various purposes, including the completion of the electrification project from New York to Washington, D. C.

Modern Equipment Speeds Rail Sawing



Six Classifications are Provided in the Storage Pit — Note the Power Roller Conveyor Along the Left

A description of the Chesapeake & Ohio rail cropping plant at Barboursville, W. Va., and an account of the manner of its operation to obtain an output of from 300 to 400 rails in an eight hour day at a cost that justifies the hauling of the rail to this central location

TO meet its growing need for a means of salvaging hundreds of tons of rail removed from main tracks but still serviceable for use in secondary and yard tracks except for the battered condition of its ends, the Chesapeake & Ohio constructed a rail sawing plant in 1929, which, with subsequent additions and improvements in equipment, is today one of the most efficient plants of its kind in the country. While the plant has only one saw, it incorporates all of the necessary auxiliaries to maintain the highest output with minimum physical effort, including practically straight-line operation through the plant, duplicate twin power drills, power head dressing and beveling grinders and mechanically-operated roller conveyors with power-operated rail stops and rail kickers.

Operated only to the extent of providing rail for the relay track program for the system, the yearly output of the plant has varied widely, but the actual cost of the sawing and drilling operations has been maintained within relatively narrow limits. In 1930, the first year of any considerable operation, 34,182 tons of rail were handled through the mill. In 1931, 36,238 tons were sawed, while in 1932, with operation part time during only six months of the year, only about 7,400 tons were sawed. The average cost of sawing all sizes and classes of rail per ton in the different years was $0.636 in 1930, $0.601 in 1931, and $0.800 in 1932. These costs include labor, supervision, supplies, 5 per cent interest on investment, and an annual amortization charge based on 25 years' life of plant. The effect of the fixed interest and amortization charges is indicated strikingly in the rise in unit costs for 1932, in which year only a relatively small quantity of rail was sawed. The unit costs for labor and supervision alone show a steady decline, being $0.394 per ton in 1930, $0.365 in 1931, and $0.302 in 1932.

Most of the rail sawed has been of the 100-lb. R. B. section, although during the last two years a considerable portion of the rail handled has been of the 130-lb. P. S. section. Rails of these sections, as well as some rails of lighter section, have been reconditioned at the plant in exactly the same manner, a 12-in. crop being made at each end and holes being provided for a four-hole joint.

Since the cutting and drilling of the larger rails requires more time than the same operations on the lighter rails, the daily output of the plant varies somewhat with the rail sections being handled. This, however, has generally been between 300 and 400 rails in an eight-hour day. The record for the plant is five hundred seven 100-lb. rails in eight working hours, or at the rate of less than a minute to the rail, for sawing, redrilling and classification ready for relaying.

Detail of Plant Layout

The rail saw plant is located at Barboursville, W. Va., within the area of the road's centralized reclamation facilities for roadway, track and signal department materials and equipment. Situated more or less by itself, the plant extends in a general north and south direction and consists essentially of unloading skids, a saw and drill house where the actual work on the rail is done,

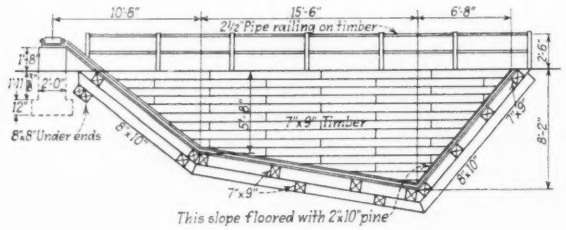
A Magnet-Equipped Crane Unloading Rails Into the Rail Saw Plant

and a storage pit for reconditioned rail, together with a roller conveyor system which carries the rails from point to point, and two standard gage tracks which extend continuously along the east side of the plant and beyond into a large general rail storage area.

The unloading skids, which are at the north end of the plant, consist of three lines of rails 12 ft. apart and at about waist height, which are anchored longitudinally on top of concrete walls. The rails, which lie at right angles

to the plant service tracks and the line of operations through the plant, serve as an inbound rail unloading rack, an inspection table, and skids for moving the rails transversely on to the plant conveyor system.

Immediately south of the skids is the building which houses the saw and the drills, and wherein all of the mechanical operations on the rail are performed. This is a steel frame structure 80 ft. long by 30 ft. wide, entirely enclosed, with sides and roof of metal sheeting, except for adequate windows and wide doorways at each end. The saw is located immediately within the building at the north end. This is a Ryerson high-speed friction saw designed especially for rail cutting work, and is similar to the saws used generally at other rail sawing plants about the country. The rail drilling is done at the leaving end of the building, where two Ryerson electrically-driven inclined rail drills, each with twin bits, are located. From the last of these drills, which are set approximately 12 ft. center to center, the reconditioned rails are moved out to the storage and loading pit.



Cross Section Through the Rail Loading and Storage Pit

Storage Pit Is 254 Ft. Long

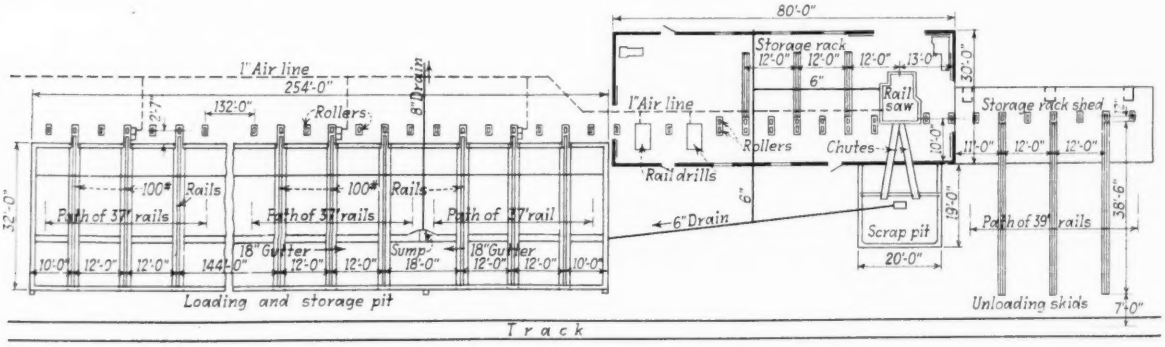
The storage pit, which, with the mechanical facilities provided for handling the rail to and into its various sections, is one of the most interesting features of the plant, is essentially a designed excavation, suitably lined, which is capable of receiving several thousand tons of rail in six different classifications. The pit is 254 ft. long, 32 ft. wide at the top, and has sloping sides, with a sloped bottom 15½ ft. across. Along its high side, the pit is 5 ft. 8 in. deep, while along its low side, which is furthest from the receiving side, it is 8 ft. 2 in. deep. This slope of the bottom was provided to assist in the normal distribution of the rails in the pit to utilize its capacity better and also to form a drainage gutter to carry all water readily to a drainage sump provided near the north end.

While continuous, the pit provides what might be called six sections or separate piling bays, each approximately 42 ft. long, amply sufficient to take 37-ft. cropped rails, which are the longest that come out of the plant. Each section has a skeleton lining of three 100-lb. rails, spaced 12 ft. apart, which extend continuously as ribs down both sides and across the bottom of the pit. The rail ribs, which take the abuse of and support the cropped rails dumped into the pit, are carried on timber stringers and blocking having bearing on the earth base and side slopes. Only the outer face of the pit, that from which loading into cars takes place, which is the steepest and subject to the surcharge of the loading track and equipment, is retained, this being with a tight sheeting of 2-in. by 10-in. pine, laid beneath the rib rails. The vertical ends of the pit are provided with a tight face of 7-in. by 9-in. timbers.

Rails Are Kicked Into Pit by Power

The conveyor system for handling the rails to the pit is essentially a series of rollers and, therefore, simple in design and construction, but of special interest is the fact that it is power-operated and is provided with pneumatic, remote-controlled rail stops and unloaders. The rollers of the conveyor are 14⅞ in. long and 5 in. in diameter, and are mounted on top of concrete pedestals spaced 6 ft. apart. They are provided with roller bearings, and a continuous guide plate along their outer ends prevents any rails from falling off on the side of the conveyor away from the pit. All of the rollers are power-operated from an electric motor, through gears and shafting, and are run at such speed that the rails are carried along at a rate of about 350 ft. a minute.

All except the first six rollers from the last drill remain in constant operation and pick up any rails passed on to them. The first six rollers are reversible through a clutch controlled by the last drill operator. Through this arrangement, the cropped rails can be run past the second drill slightly and then backed up against a stop in exact position for drilling the bolt holes at the rear end. When the drilling is completed, the forward motion of the rollers carries the drilled rail away from the drill and brings another rail up into position.

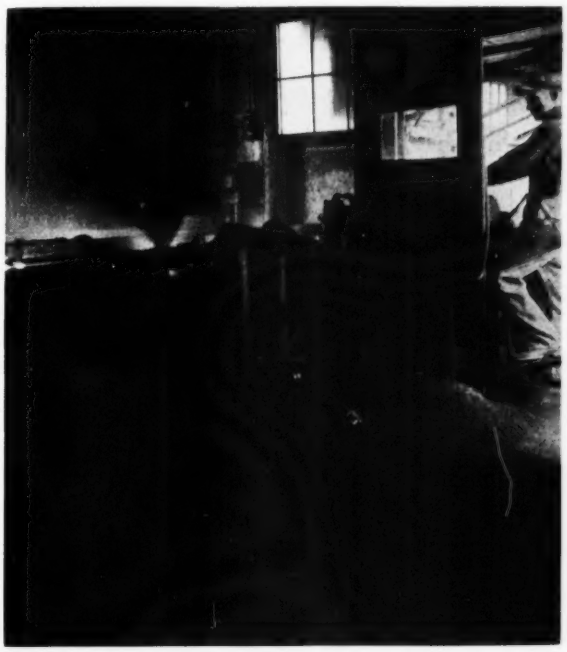


General Layout Plan of the Chesapeake & Ohio Rail Saw Plant

Discharge of the rails from the conveyor into the pit, in accordance with their proper classification, is done by air-operated stops and kickers controlled by a series of lever-operated valves directly behind the working position of the last drill operator. The stops, which are merely steel paddles or plates located in the conveyor line at the far end of each pit classification, are each so arranged with an air cylinder that, at the will of the operator, any one of them can be thrown up in the path of rails moving on the conveyor.

Each of the stops is interlocked with two air-operated rail kickers, located at about the third points of the classification section governed, which, when the stop is forced

backward by a rail, are brought into play automatically and, rising through the bed of the conveyor, lift and force the rail inward into the pit. Kicked with sufficient force, the rails normally adjust themselves over the area of the pit in the lower levels, but as they do have a tendency to pile up on the conveyor side as the depth of the rails increases, the uneven piling is offset somewhat



The Rail Saw in Operation—Transverse Conveyor in the Foreground Carries off the Cropped Rail Ends

by deflector plates bolted near the top of certain of the rib lining rails, which throw the cropped rails further outward toward the center of the pit. When uneven piling tends to obstruct further unloading into the pit, a crane with a magnet, operating on the nearest service track, readily levels off the pile or loads out some of the rails for delivery on the road or for storage elsewhere.

The rails receive a severe lateral shock when dumped into the pit, but this is not of such character as to injure them. At the same time, it is sufficient to break any rails containing large transverse fissures and has proved distinctively valuable in this respect.

Rails Are Carefully Graded

In handling rails through the plant, the rails are first set off on the unloading skids from cars by a magnet-equipped crane, the rail coming either direct from the road or from storage piles. Three magnet-equipped cranes are available at the reclamation plant for use by the rail sawing plant, although only one is assigned definitely to rail handling work while rail sawing is in progress. Depending upon the arrangement of the rails to be handled, the magnets used can pick up from three to six 130-lb. 39-ft. rails, although as many as nine such rails have been picked up at one time.

On the unloading skids, the rails are first turned up workwise by two men, who also clip off any old bond wires, and then a rail inspector, or grader, examines each rail carefully and designates its grade or classification on the side of the head in the form of white paint marks. Six usable classifications and scrap are provided for, these being based essentially on the rail section, the amount of vertical and side head wear, the condition of surface and alinement, and defects such as wheel burns, corrugations, base breaks, or any of the various types of internal defects which may be detected by visual inspection.

As graded, the rails are skidded laterally to a roller conveyor and are turned on their side so that the base will face the saw and will be cut first. As first placed on the conveyor, the advance end of a 39-ft. rail is only about 16 ft. from the saw. Thus, the rails are readily pushed into position for the advance end crop. Scrap rails are pushed over the conveyor in the direction away from the saw and are stored on a nearby rack for disposal at any convenient time.

Cuts Made in 9 to 18 Seconds

At the saw, the advancing rail is brought against a stop set by air by the saw operator, which brings the rail into proper position for the cut at the forward end. Air-operated clamps then force the rail against side alinement plates and the advancing friction saw disc, controlled by the saw operator, makes the cut. Depending upon the section and hardness of the rail, the time required to make a cut varies from about 9 to 18 sec., the usual time being from 9 to 11 sec. for 100-lb. rails and from 14 to 18 sec. for 130-lb. rails.

After the first cut, the rail is pushed forward on the conveyor until the position of the rear end cut is reached. While this cut is being made, a man with a hammer at the advance end of the rail knocks off any saw burrs from the web and base flanges. The cropped rail ends fall through a gap in the main conveyor and on to a short transverse roller conveyor set on an incline of about 30 deg., over which they are carried by gravity for a distance of about 16 ft. to a scrap pit. This pit, designed specifically for the purpose, is about 18 ft. square and 9 ft. deep, and is provided with a drainage sump at the bottom which has connection with the drainage line

The Two Power-Operated Twin Drills, Their Operators, and Men Who Dress the New Ends With High-Speed Air Grinders

from the sump in the rail storage pit. Since the pit is located just outside the building and alongside the inside service track, the scrap rail ends are readily removed from it periodically by one of the magnet-equipped cranes.

Bolt Holes Drilled in 25 to 35 Seconds

Upon the completion of the rear end cut, the rail is advanced a few feet and then, by means of air-operated kickers, controlled by the man at the advance end of the rail, is pushed laterally through a distance of about 15 in. on to a parallel roller system in line with the power drills. In its new position, the rail is moved forward a few feet,

which brings its advance end under the first drill. Here, while both bolt holes are being drilled simultaneously, a man with a hammer knocks off any saw burrs on the web and base flanges at the rear end of the rail.

When the holes at the advance end of the rail have been made, which requires from 25 to 35 sec., depending upon the thickness of the web and the hardness of the metal, the rail is advanced on power rollers of the main conveyor system to a position such that its rear end is brought into proper position under the second drill for drilling the two bolt holes in that end. As already pointed out, operation of the rollers immediately beyond the second drill is reversible, so that the rail can be passed slightly beyond the drill and then readily moved back against a guide stop for accurate drilling.

Grinding Off Burrs and Beveling

While the drilling is under way, advantage is taken of the delays in the forward movement of the rail to grind off any saw burrs on the head at the ends, and also to chamfer or bevel the top of the head at both ends. This is done at the advance end while the advance bolt holes are being drilled, and at the rear end while the rear holes are being drilled; in each case by an Ingersoll-Rand high-speed air turbine grinder in the hands of an operator. This operation is readily completed within the drilling period, any burrs being removed by one or two passes of the grinding wheel, and the cut back of the bevels being made to a distance of approximately 1/16 in.

As the work on the rear end of the rail is completed, the last drill operator starts the rail on its way over the storage pit conveyor and, at the same time, by means of the control levers directly behind him, sets the proper stop in the conveyor line to discharge the rail into the proper section of the pit in accordance with the painted classification marks on it. As the advance end of the rail knocks the stop backward, the rail kickers at the specific classification point come into play and force the rail off from the conveyor laterally and into the pit.

14 to 18 Men Operate Plant

The force employed in the rail sawing plant operation is as follows:

Four men with the crane, including two ground men, a crane engineer and a fireman.
Five men at the unloading skids, including two men who turn the rails up in workwise position and remove bond wires, one rail inspector or grader, and two men who move the rails to the saw conveyor.
One saw operator, who operates the friction saw and the stops in connection therewith.
Two men who knock saw burrs from the web and base flanges at each end.
One man who assists in moving the rail to the first drill.
Two drill operators.
Two grinder operators, and
One plant mechanic.

With this force of 14 men in the mill proper and 4 men on the locomotive crane, the duties of which are all synchronized with each other and with the machine operations, the rails move through the plant in constant succession, passing out to the storage pit with completely reconditioned ends, classified and ready for further service, at the rate of one every 60 to 100 sec.

The rail saw plant was designed and built by company forces under the direction of C. W. Johns, chief engineer, and C. J. Geyer, engineer maintenance of way, and under the immediate supervision of Walter Constance, supervisor of reclamation. It is operated under the direction of J. E. King, now engineer maintenance of way, represented at the plant by Mr. Constance.

Erie and N. & W. Make Track Inspections

THE results of the annual track inspections on the Erie and the Norfolk & Western, in the course of which the various divisions, subdivisions and sections were rated according to the standards of maintenance prevailing, have been announced and are abstracted below.

Erie Made Usual Inspection

The Erie has made the usual annual inspection of all of its tracks, using its special inspection car, and certificates were again awarded to the two main-line supervisors on each of the road's two districts whose territories received the highest and second highest ratings, and similar awards were made to those supervisors who maintained the best branch lines on the Eastern district. Following are the supervisors who received the main-line and branch-line awards:

Division	District	Award
	Eastern District—Main Line	
Susquehanna	W. E. McGuire, Binghamton, N. Y.	First
Susquehanna	F. Fisk, Hornell, N. Y.	Second
	Eastern district—branch lines	
Greenwood Lake	T. J. Leonard, North Newark, N. J.	First
Buffalo	W. L. Kelly, Buffalo, N. Y.	Second
	Western district—main line	
Allegany	P. J. Davidson, Salamanca, N. Y.	First
Marion	W. H. Leatherman, Decatur, Ind.	Second

Supplementing the above awards to supervisors, a "Banner" section was established on each district and a considerable number of first and second certificate awards were made to the foremen whose sections received the first and second highest ratings on the different subdivisions. The "Banner" section award on the Eastern district was given to Tindaro Vallato, foreman on Section 8, Subdivision 1 of the Terminal division, and the "Banner" award on the Western district was made to C. E. Keller, foreman on Section 20, Subdivision 2 of the Marion division.

Eighty-One Win Prizes on N. & W.

Eighty-one foremen on the Norfolk & Western divided a total of $2,090 in prize awards as a result of the annual track inspection held on that road in 1933. As in the past, first, second, third and fourth prizes of $40, $30, $20 and $10, respectively were awarded generally on each district.

In accordance with previous practice on this road the inspection was made by separate committees on line and surface, switches and frogs, ditches and roadbed, right-of-way, station grounds, and road crossings. On the basis of 10 as perfect the system rating for the year was established at 9.24.

On the basis of 10 as perfect, the highest rating given to any section in 1933 was to that of Ernal McCann, on the Scioto division at Sardinia, Ohio, which received a rating of 9.49. The second highest rating of 9.47 was awarded to the sections of Brooks Campbell at Duvalls, Ohio, and W. V. Crosby, at Lockbourne, Ohio.

The highest division honors were divided between the Roanoke terminal and the Scioto division, each of which attained a general average of 9.33. The Pocahontas division was next in line, with a general average of 9.27. The highest rating given to any roadmaster's district was to the Vera-Cincinnati district, with a grade of 9.37, while the second highest rating of 9.36 was given to the Greggs Hill-Columbus district.

Why Spring Washers Are Used*

A detailed analysis of the functions and advantages of these devices in the proper maintenance of rail joints

THE original name of spring washers was "nut locks," and they are still so called erroneously by a large number of railroad men. Not until the American Railway Engineering Association issued specifications covering these devices in March, 1923, was their correct name, "spring washers," substituted. Why should these devices be called spring washers and not nut locks? Because the term "spring washer" more accurately defines the principal functions they are designed to perform.

The term nut lock was applied originally because of a misconception of what was happening in a joint. Trackmen were periodically tightening bolts and it was thought that this wrenching was made necessary because the nuts were backing off. Hence a device was needed to lock the nuts in position.

In the study of joints and joint conditions, it was only natural that certain individuals inaugurated tests of nut locks. In the test stretches provided, certain joints were equipped with nut locks while at other joints they were omitted. The nuts were marked so that any backward movement could be detected. With exceptions so rare as to be negligible, the surprising fact was developed that there was no back turn. There was no need for a nut lock. As a matter of fact, at that time, practically all nuts were "wrench fit." This tight fit was more than sufficient in itself to prevent any back turn. As a result, it was concluded that bolt looseness must be due to some other cause than back turn of the nut.

Compensation for Bolt Stretch Needed

In those days bolts were not only inadequate in diameter but were made of ordinary carbon steel with a low elastic limit and ultimate tensile strength. Heat treatment was unknown. It was not difficult for a trackman to strain a bolt beyond its elastic limit or to break it as well, and to do this did not require the use of a pipe extension on the wrench. The result was that the bolts stretched, kept on stretching, and ultimately broke. This stretching was then one of the principal causes of bolt looseness. Since that time, modern heat treatment of bolts and adequate diameters have practically eliminated the stretch of bolt, although if it should take place, a device to compensate for the resulting looseness was required, and not a nut lock.

Again, in addition to the ordinary material used in the manufacture of nuts and bolts, which was conducive of stretching, the accuracy of manufacture and nicety of fit were none too good. The differential in the pitch of the threads of both bolts and nuts was so large that the mere wrenching on of the nuts caused injury to the threads of one or the other—usually those of the nut, because of softer material. The threads of the nuts and bolts had to conform to each other and in doing so were stressed beyond their elastic limit. Only a few of the threads, sometimes only one, were engaged, and, as a result, they gave way or were actually stripped. This then, was another principal cause of loose bolts, which required a compensating device and not a nut lock.

As time passed, axle loads increased, the rail was made heavier, joint bars were enlarged, bolts were increased in diameter, and, in fact, every part of the track was enlarged and improved except the lowly nut lock. It remained generally a ¼-in. by ¼-in. ring of ordinary steel. True, the more courageous maintenance of way man began to make requisitions, not only for so many thousand nut locks, but had the boldness to specify ⅜-in. by ¼-in. section and then ⅜-in. square. This was thought to be rash extravagance by many. The nut lock, however, was beginning to develop.

Spring Washers Overcome Wear

With the elimination of practically all looseness of bolts due to bolt stretch, brought about by heat treatment and adequate diameters, looseness of bolts continued all too prevalent. If it was not caused by back turn of the nut or stretch of the bolt, what caused it? The answer is the inevitable wear of the contact surfaces of the joint bars and the rail. Since this wear was inevitable, the necessity for devices to compensate for it became apparent. A spring washer and not a nut lock was essential, and that is the reason, as developed logically step by step from actual facts, why the name spring washer is more correct than nut lock.

Joint bars are wedges that are forced into and held in position by the bolts. When a wheel is directly over a joint, the angle bars are twisted. The bottom of the center of the bar moves inward toward the web of the rail and the top of the bar at the ends moves outward. Just the reverse of this twisting action takes place when two wheels are on opposite sides of the joint. Therefore, under every moving wheel abrasive action is set up between the contact surfaces. As a result, the bars are constantly being forced by the bolts closer to the web of the rail and the tension in the bolts is lowered. If no compensating devices are provided, the bolt tension will soon drop to zero and the bolt will be loose.

With no compensating devices on the bolts, we can still count on the elastic elongation (not stretch) of the bolt itself to some extent. How much? Under the tension put in a bolt by the average trackman, say about 20,000 lb., the elastic longation will be about 0.0047 in. This is equivalent to about 1/25 of a full turn of a nut. Expressed in a different way, if, after wrenching up a bolt that is not equipped with a spring, wear takes place to the minute extent that each joint bar has moved toward the web of the rail 0.0023 in., the bolt tension will have dropped to zero and the bolt will soon be loose. It will be clear, therefore, that the amount of compensating ability in the bolt through its elasticity is too small to be of any practicable value. From what has preceded it will be clear why a device capable of compensating for wear is essential.

While compensating ability is one essential function of a spring washer, it is only one of the important functions it should perform. In addition, and of even greater importance, it should serve to retard wear. Furthermore, if, due to lack of adequately strong spring washers, utter rigidity exists, the joint bars will "freeze," and expansion and contraction of the rail will be prevented or inter-

*A paper presented before the Metropolitan Track Supervisors' Club of New York, by W. R. Hillary, National Lock Washer Company.

fered with. The small but essential resilience afforded by the spring washers will tend to promote the necessary expension and contraction of the rail.

Without adequately strong spring washers, uniformity of bolt tension is impossible. Imagine, as I have seen, a joint with no spring washers, in which every bolt has about 20,000 lb. tension, except one, and that is loose. When the loose bolt is tightened, the two previously tight ones adjacent may and usually are made entirely loose. Every bolt in the joint, therefore, must be wrenched. Spring washers act as equalizers of bolt tension and, as a result, prevent any bolt from shirking its share of the load.

A characteristic condition of bolts with no spring washers is "frozen" bolts. The threads ahead of the nut come in contact with the joint bar and are damaged. After a few tightenings, the nut reaches these damaged threads and jams, making further tightening impossible. Corrosion soon practically welds the immovable nut to the bolt and it is "frozen." To overcome this trouble, nuts may be recessed, but if this is done, the bearing area of the nut is reduced, and the nut should be increased in thickness to compensate for the threads removed by the recess. Both recessing and increased thickness of nut add to the cost.

Modern joint bars have, in most instances, a projecting rib on the top flange, which frequently makes some kind of washer necessary in order that the corners of the nut will clear the rib. One expedient employed to make the use of a washer unnecessary is to chamfer the corners of the nut, but this again reduces the bearing area of the nut and, in turn, brings about more rapid wear and, therefore, loss of bolt tension. The projecting rib makes it more difficult to get an effective wrench hold on the nut, which results in damage to the corners of that part of the nut that the wrench is able to engage. This makes it difficult to secure a wrench hold and increases the time and cost of wrenching. The inadequate wrench hold also is a menace to safety for the wrench may, and frequently does, slip off, resulting in a fall for the trackman, if nothing worse.

Added Cost Fully Justified

About the only objections raised to spring washers are their initial cost (as compared with none), and the fact that a longer bolt is required. When it is remembered that the cost of the washers is such a small proportion of the cost of the rail, joint bars and bolts which they protect, and the life of which they prolong, and since it can be shown that such life has only to be lengthened a few months to justify the additional cost of washers, this additional cost may well be considered, as one railroad man expressed it, "as a paid-up policy of rail insurance." The initial cost may also properly be considered as a very profitable investment.

As to the increased length of bolt—that might amount to as much as ¼ cent per bolt. If no spring washers are used and the nut is recessed to protect the threads on the bolt, then, as previously stated, the thickness of the nut should be increased by the depth of the recess so that the number of threads and the gripping power of the nut will not be reduced. Such a nut would require as long a bolt as a thinner one with a spring washer.

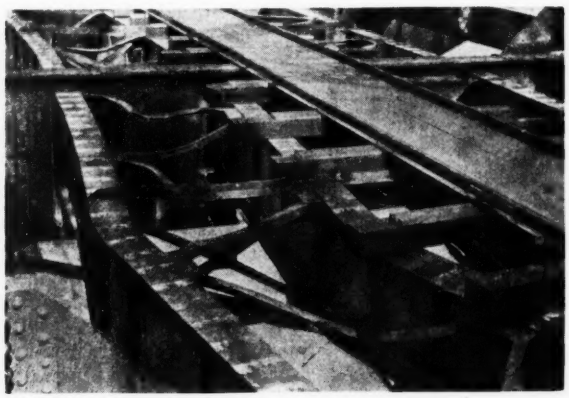
Spring washers are not a cure-all. They alone will not overcome all of the joint troubles. However, in conjunction with other well-designed and fabricated parts of a joint, they will do their full share in providing an efficient, economical joint requiring a minimum of intelligently applied labor in maintenance.

Menace of Bridge Fires

(Continued from page 19)

the ties themselves but perhaps jeopardize the safety of the supporting steel work.

Mention has been made of hot coals from locomotive ash pans as a menace to decks of bridges. The modern locomotive has been so improved in recent years that there is little excuse for failure of this detail under conditions of proper supervision and maintenance. Slides for ash pans should be so arranged that they cannot be operated from the cab. When the locking pin is put into position it should be held in place automatically by



An Example of the Distortion of Bridge Steel Resulting From the Burning of the Wooden Deck

hinging the end of the pin, so that the end section drops to a position at a 90-deg. angle to the axis of the pin. An "S" hook on the chain is also a recognized locking device.

Even with any of these necessary mechanical preventive devices, special inspection of the locomotive before it leaves the terminal should be made to assure that, even if the position of the operating lever is apparently correct, the slide is fully seated. An additional precaution is to instruct engine crews not to disturb the fire either by shaking or by operating the slice bar immediately prior to and while the engine is passing over important bridge structures.

Improvement in Locomotive Grates

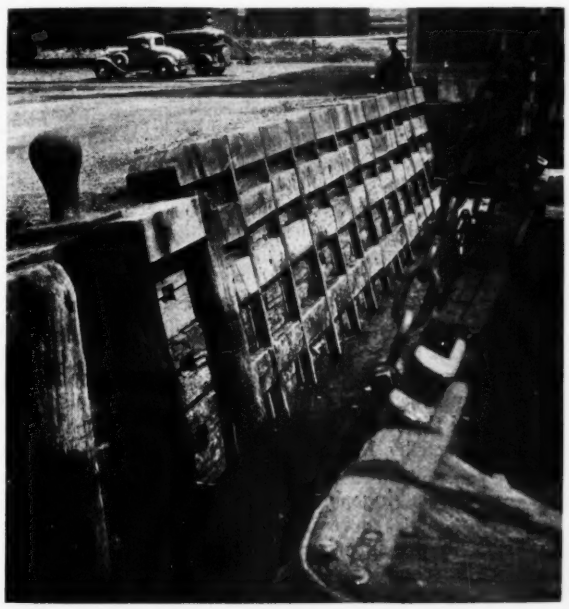
Much improvement has also been made mechanically in the form of grate used in locomotives. The older type of grate was first superseded by flat grates with a series of round holes. Still more recently the type known as the firebar grate has made it possible to replace small areas of the grate surface by renewing the individual sectional castings rather than to renew the entire grate. The amount of wear between sections is limited by inserting fillers when the spaces between the units exceed the allowable clearance. The openings in a complete grate surface are so small that no cinder of a size exceeding ⅜ in. can pass through to the ash pan.

Some locomotives have flush pipes in the ash pans. On account of the possible choking of valves operating this device, with water direct from the boiler and under boiler pressure, it has been found advisable to limit their use to such times as the locomotive is standing over ash pits. With mechanical improvement of the operating mechanism, it may later prove advisable to have the flush pipes operated in the ash pan before the locomotive reaches any bridge, the deck of which is to be absolutely assured against fire communication from a locomotive ash pan.

Fenders of Scrap Rail Protect Bulkheads

WITH approximately 3,000 ft. of intensely developed waterfront at its freight terminal at Weehawken, N. J., on the west shore of the Hudson river, the Erie is confronted with the problem of frequent repairs to the bulkheads in the slips between piers, the vertical fender piles of which are subjected to heavy battering and "chewing" action by the impact of floating equipment and the constant friction of barges and lighters moored to the bulkheads.

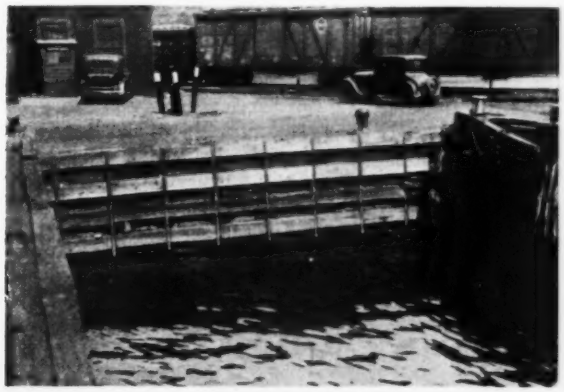
Determined to minimize this damage and the resulting maintenance expense, the road began experimenting in 1929 with the use of scrap rail fender pieces, substituted essentially for the vertical fender piles and designed to take the abuse to which these piles are subjected normally. The first installation demonstrated the practicability of the rail face construction so clearly that all recent bulkhead fender repairs conform to the new design.



A Short Section of Bulkhead With the Scrap Rail Fender Construction

The normal bulkhead construction along the Erie waterfront is not unusual for the type of soil river bank encountered, consisting essentially of a pile foundation below mean tide, surmounted by a solid face wall of 12-in. by 12-in. timbers, anchored back into the ground by header timbers and protected on its water face by oak or pine fender piles, 30 to 35 ft. long, placed on 3-ft. centers. The foundation consists of three longitudinal rows of untreated piles, spaced six feet center to center, with the piles four feet center to center in each row. These piles are capped with 12-in. by 12-in. timbers and then provided with a solid deck of similar timbers which supports the back-fill of the bulkhead face. The headers of the face, which are generally second-hand timbers, are located in vertical rows at intervals of about four feet along the bulkhead, with the timbers in each row from 18 to 30 in. apart, one above the other, embedded in the back-fill.

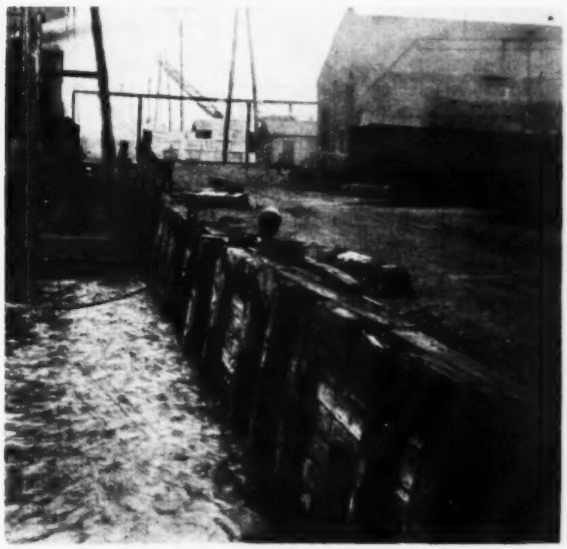
Of such construction, the bulkhead itself has proved of long life, the damage being confined largely to the vertical fender piles along the face, which absorb the impact and rubbing action of the boats. The seriousness of the damage to the fender piles and the repair problem resulting is seen in the fact that, under the service requirements of normal business, yellow pine fender piles have a life of only 12 to 18 months, and new oak piles have a life of only 2 to 3 years.



After More Than Two Years Service This Bulkhead is Still in Perfect Condition

In the new construction, the fender piles are completely done away with and are replaced by 11-ft. lengths of 90-lb. scrap rail, spiked vertically to the bulkhead, 42 in. center to center, and held apart by four lines of 5-in. by 12-in. oak separator pieces. Ordinary track spikes, placed as in track construction, hold the fender rails, with the exception that one spike is driven through a hole burned in the base of each rail to keep it from slipping downward.

The oak separator pieces, which are cut from available old ferry slip fenders, are placed in horizontal lines 21 in. to 24 in. center to center and are spiked directly to the bulkhead face by ½-in. by 10-in. boat spikes. To insure lateral support to the rails and to prevent the separator pieces from falling out if knocked loose, the ends of each piece are cut to fit snugly against the sides of the rails.



Fender Piles of the Old Bulkhead Construction Required Renewal in One to Three Years

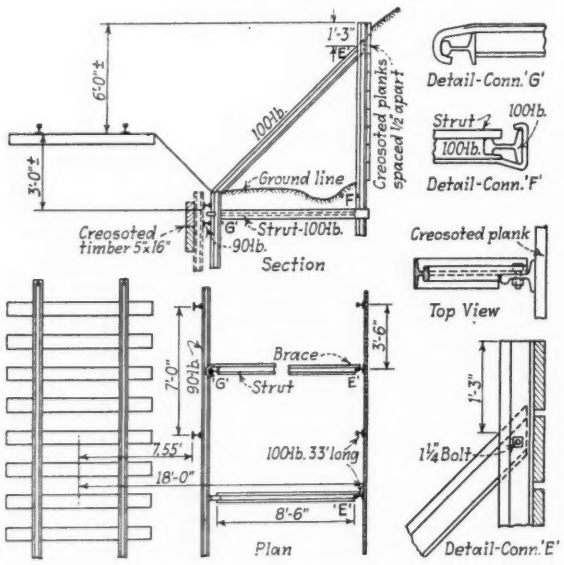
Two of the most important factors in the successful

use of the rail fender construction are to afford a uniform support for the rails on the bulkhead face timbers and to space the horizontal lines of separator pieces close enough together to prevent the corner nose irons of barges and lighters from getting in between them and ripping them out. Several rails were broken in the first installation owing to the impact of boats against them where they were not fully supported, but with greater care in subsequent installations, adzing the bulkhead face timbers or using shims where necessary, none of the fender rails in these installations have been broken and the bulkheads are in exceptionally good condition, some after two or three years of service. So satisfactory and economical has the construction proved that it is planned to use it in all future repairs of this nature.

The rail fender construction was developed under J. C. Patterson, chief engineer maintenance of way, and is being installed at Weehawken under the direction of I. H. Schram, engineer maintenance of way, and F. C. Kronauer, division engineer. All installations of the new construction have been made by the carpenter forces of the road under A. M. Axelsen, master carpenter.

Hold Slide with Retaining Wall of Scrap Rails

A RETAINING wall constructed of scrap rails was the means adopted by the Louisville & Nashville to control a slide in a side-hill cut at Bangor, Ala., which had induced a track condition that was requiring excessive maintenance expenditures. Previous to the construction of the wall, the slide was the cause of serious



Details of the Retaining Wall

heaving of the track and made it necessary to remove the sliding material several times a year. This method of correcting the condition was chosen because the unstable character of the foundation material would have rendered any other type of wall construction exceedingly difficult and expensive.

This wall consists of a frame of steel rails that provides the necessary support for two diaphragms of creosoted wood, an outer one 18 ft. from the center line of the track that retains the sliding material, and another buried in the roadbed 7½ ft. from the center line of the track, which acts as the toe to transmit the thrust of the lateral earth pressure to the roadbed. The steel frame is designed also to transmit this thrust from one curtain wall or diaphragm to the other.

The outer curtain wall consists of 2-in. planks bolted in a horizontal position against a line of 100-lb. 33-ft. rails 3 ft. 6 in. apart driven vertically, with their heads facing the track and their upper ends about 6 ft. above

View of the Completed Wall

the base of the rail. The planks are separated ½ in. for drainage.

Alternate rails in the retaining wall are strutted by inclined braces formed by 100-lb. 33-ft. rails driven vertically on a line 8½ ft. from the center line of the track with their upper portions bent over at the ground line and bolted to the rails in the outer wall at a level 15 in. below the top. These braces are connected to the vertical rails by removing the bases and heads on corresponding sides of both the brace rails and the vertical rails so that the webs of the rails fit together in lap points, the joints being fastened by 1¼-in. bolts.

Ingenious Connections

The earth pressure is resisted at the bottom of the wall by horizontal struts connecting the two lines of 100-lb. rails below the ground line. The connection of these struts to the outer line of rails is made by cutting away the head and web of the strut rail for a sufficient distance to permit the base to be bent into the form of a hook that fits around the base of the upright rail. At the other end, the connection is somewhat similar except that here the head of the rail is hooked about the vertical section of the diagonal brace rail, with the web and base of the former bearing against the base of the latter.

The thrust thus transmitted to these horizontal and inclined struts is transmitted to the roadbed by means of a frame composed of two horizontal lines of 90-lb. rails with their bases bolted to another line of vertical 100-lb. rails spaced 7 ft. apart that bear against a diaphragm consisting of two 5-in. by 16-in. timbers that are fastened to the bases of the vertical rails.

While this wall has not been in service a sufficient length of time to determine conclusively that it has solved the slide problem, it is said that there is every indication that the results will be satisfactory. The cost was about $8 a lineal foot. This project was carried out under the supervision of R. N. Crapster, division engineer at Birmingham, Ala. We are indebted for the information contained herein to J. R. Watt, engineer maintenance of way of the L. & N.

What's the Answer?

Send your answers to any of the questions to the What's the Answer editor. He will welcome also any questions that you may wish to have discussed.

Bucking Snow

When entering a cut in which there is a probability of stalling, to what extent should the flanger on a snow plow be raised and the wings pulled in? Why?

Thinks Flanger Should Be Raised

By E. H. PIPER

District Engineer Maintenance of Way, Chicago, Burlington & Quincy, Omaha, Neb.

When entering a cut filled with snow, particularly if it is heavy, the flanger should under no circumstances be in flanging position. The hazards in connection with bucking snow are in themselves of sufficient magnitude without adding to them. When entering cuts that are filled with snow, one never knows in advance whether the plow will be derailed or stalled. Letting down the flangers when bucking snow drifts adds materially to the possibility of stalling as well as to that of derailments. If flanging is considered necessary, it should be done after the cut has been opened for traffic. Flangers on modern snow-fighting equipment are so designed that they may be handled mechanically, requiring but a few moments to let them down into flanging position.

Side wings should be left in the position that will give the desired clearance to the equipment in trains, which generally is not very much. This clearance should be held as close as practicable, thus reducing the probability of stalling the snow-fighting train. In using a rotary snow plow, the matter of side clearance is taken care of automatically, since with this type of plow, the width of the cut it makes is not adjustable, except by the addition of side plates, which I believe is seldom done.

When bucking snow, the possibility of becoming stalled or being derailed is always present. For this reason, the snow-fighting equipment should always be kept in the best shape possible. Delays of this character are expensive, not only because traffic is held up, but because of the labor and time involved in getting the snow-fighting equipment out of the difficulty.

Would Always Keep Flanger in Operation

By L. H. ROBINSON

Division Engineer, Canadian National, Halifax, N. S.

It would be a mistake to raise the nose on a wing plow equipped with a drop nose for flanging, when entering a badly drifted cut. By doing so, a bad flangeway is left and the tendency is increased for the locomotive to slip, or "lose her feet." If there is ice or slush in the bottom of the cut, as there often is, the nose should be in working position or a derailment will result. The resistance offered by the nose is only a small part of the total plow resistance.

It would be an equally bad mistake to pull in the wings before hitting a badly drifted cut, for much the same reason. The resistance offered by the inclined wings constitutes only a small part of the total plow resistance. Furthermore, the straighter and narrower walls left when the wings are drawn in result in snow falling on the rail and decreasing traction. When in operating position, the wings assist the moulded sides of the plow in throwing considerable of the snow far from the track, this effect being lost when the wings are folded in. In drifts in which the snow is heavy and well compacted, the wings are often forced in against the air pressure. In such instances it is routine practice, after passing through the cut, to back up and buck the cut a second time, or as often as may be necessary to attain the full width of the wing.

In bad snow territory where heavy snowfall and drifting are of common occurrence, it is our practice to double-head our heaviest locomotives on the snow plows that are operated over important main lines. This is done as often as may be necessary to keep the line open. It may be a serious matter to stall a snow-plow train, since this may result in tying up the main line for several days. We never take a chance on letting the drifts get so far ahead of us that the small extra resistance of nose and wings will be likely to result in the stalling of the train. The plows are always operated at speed. When the cuts become walled up so badly that the wings can no longer throw the snow into the clear, butterfly and rotary plows are used to break them down and give room for the wings.

On branch lines where the frequent operation of snow plows cannot be justified, different methods are employed. The roadmaster knows where the bad cuts are and where trouble may be expected. When approaching such

To Be Answered in March

1. *To what extent is a road warranted in transposing the inner and outer rails on curves when they become worn? Are there any disadvantages?*
2. *What is the best method of storing fuel oil at water stations where internal combustion engines are used?*
3. *What are the advantages and disadvantages of fastening tie plates to the ties independently of the rail? How does this form of construction affect track maintenance?*
4. *Under what conditions are crib walls of metal or concrete units preferable to solid masonry walls? What are their limitations? What precautions are necessary in their construction?*
5. *When slides endanger the track on embankments, how should temporary repairs be made? How do locomotive cinders compare with other materials for restoring the embankment?*
6. *Where an annual building inspection is made in the fall, is there any advantage in making a similar inspection in the spring? Why? If so, what items should be noted particularly?*
7. *Are gage plates, or gage rods immediately ahead of the switch points, preferable for main-line switches? For yard switches? Why? Does it make any difference whether the turnout is on tangent or curve?*
8. *What are the evidences of loose rivets? What does their presence indicate with reference to the condition of the structure?*

places, one locomotive is cut off and the plow and one locomotive are sent into the cut. Just as the drift is reached, steam is shut off and the momentum is depended on to carry the plow some distance into the snow. A careful watch is kept, and just before the plow stops, the wings are pulled in and the locomotive is reversed. This permits backing out without stalling. This process is repeated, the plow going a little farther every time until it finally emerges at the other end of the drift. The remainder of the train is then picked up and proceeds to the next drift. This method is called "bunting."

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How Do Treated Ties Fail?

In what way do treated ties fail? Untreated ties? What are the indications of decay and how do they differ?

Both Classes Fail from Same Causes

By H. S. TALMAN
Supervisor, Chesapeake & Ohio, Thurmond, W. Va.

Treated ties fail in service and must be replaced because of (1) mechanical destruction; (2) splitting; (3) decay; (4) external damage from accidents or fire; (5) softening of the fibre, especially in softwood ties, and consequent crushing under the rail; and (6) breakage because of center-bound track.

My experience indicates that treated and untreated ties both fail from the same causes and in the same ways. Decay is more common in untreated ties, however, and causes earlier failure than in treated ties. An untreated tie rots on the outside while the heart remains sound, except that sometimes decay works into the heart from the end. In other words, the progress of decay is from the surface toward the interior. Decay in treated ties is nearly always found in the heartwood and is difficult to detect unless the track is raised out of the ballast. Because the shell of treated wood may remain intact, decay in treated ties can seldom be detected when spotting ties where the cribs are full of ballast. Untreated timber often shows distinct evidence of rot in the sapwood, when the body of the tie is really sound. Any experienced trackman can easily detect this condition.

I have on my territory a very large number of treated ties, many of which were installed in 1917. Not one of these ties, even of those that have been in for 16 years, has been removed because of decay, although we have taken out quite a number because of mechanical wear.

Gives Five Reasons for Failure

By JULIUS M. BISCHOFF
Office Engineer, Terminal Railroad Association of St. Louis, St. Louis, Mo.

Treated ties fail, or at least they are replaced, (1) because they become "spike killed," owing to repeated gaging of the track; (2) because they wear through mechanical action due to the use of tie plates that have inadequate bearing area, or by rail cutting where tie plates are not used; (3) from being burned by hot cinders dumped when cleaning ash pans and grates; (4) because of broken ends due to improper tamping, or by breaking near the middle in centerbound track; and (5) from decay, as a result of improper treatment, checking or injuries that extend below the zone of treatment, thus allowing decay-producing organisms to reach the untreated wood.

Untreated ties fail from the same causes, except that decay is a much larger factor, since all of the surface of untreated ties is exposed to infection, as well as the deeper parts of the wood through checks and injuries.

From a record of tie replacements in the period from 1927 to 1932, inclusive, which included all of the causes of replacement, the following percentages have been obtained covering the six-year period:

	Treated Ties, Per cent	Untreated Ties, Per cent
Spike killed	20	17
Worn mechanically	42	12
Burned	11	1
Broken	7	3
Decayed	20	67

The decayed treated ties were pine ties treated with zinc chloride. They were all purchased and installed during 1917 and 1918. The first red oak ties treated with creosote were installed in 1922, and none of these have as yet been replaced. The use of large tie plates fastened to the ties independently of the rail fastenings will reduce the number of replacements causd by mechanical wear.

Causes Can Usually Be Traced

By W. H. SPARKS
General Inspector of Track, Chesapeake & Ohio, Russell, Ky.

There are definite reasons why some treated ties have long service life while others last only a short time. Excluding external damage, such as results from derailments and similar causes, the reasons for failure fall into six groups: (1) The character of the wood; (2) the preservative employed; (3) method of treatment; (4) methods of handling prior to insertion; (5) methods of insertion; and (6) track and traffic conditions.

It is not debatable that the character of the wood from which the ties are made has much to do with the length of their life, and a measurable influence on the manner in which they fail. In brief, certain woods tend to check and split beyond any remedial action that can be taken after they are in the track, thus exposing the untreated interior; others tend to cut or crush under the rail, even where large tie plates are used; while still others do not have sufficient resistance to horizontal forces, allowing the gage to widen and eventually fail through spike cutting.

The preservative should be adapted for the wood that is being treated and the climatic conditions under which it is to be used. If these considerations are ignored the life of the tie and the type of its failure will be affected. Experience has shown that preadzing and preboring, together with sufficient penetration and retention of the preservative, will extend the life of any tie and at the same time will be a factor in the way it fails at the end of its service life. Where ties are not prebored, they are more prone to fail from decay around the spike holes.

While the foregoing factors are not under the control of the trackmen, they have a real influence on the service life and the ways in which treated ties fail. From this point on, except so far as these factors intervene, the trackman or the conditions under which he must work are largely responsible for the type of failure.

There is probably no more useless cause of tie failure than the mishandling of the treated timber before it is inserted in the track. This nearly always results in decay and early failure. Many roads have instructions covering the handling of treated ties and these should be followed strictly to avoid damage and exposure of the untreated wood.

When inserting ties, care should also be used to avoid damage. The use of picks or shovels to drag the tie into place leaves openings for the admission of water

and organisms to the interior of the timber, with the result that the tie will fail from decay long before it should. Other forms of abuse that have the same result are the use of spike mauls or the ends of lining bars for shifting the ties to proper position, failure to drive the spikes in the prebored holes, redriving spikes without plugging the holes with treated plugs, and adzing to improve the bearing.

Ties that are not properly tamped under the rail and well toward the center of the track, but have a solid end bearing often break under the rail. Many ties have been broken near the middle as a result of center-bound track. Probably the largest number of failures in both treated and untreated ties occur under the rail. This includes rail cutting, abrasion of the wood fibre under the tie plates, especially where small tie plates are used, damage from heavily ribbed tie plates, spike cutting as a result of regaging, crushing of softwood ties, and decay, which usually accompanies all of these forms of damage. Poor drainage and consequent churning of the ties softens the wood fibre and eventually accelerates failure from any of the foregoing causes. The use of softwood ties on curves generally results in failure under the rail from one or more of the causes mentioned.

While use, as represented by the volume of traffic, is a factor in the failure of ties, it is generally overshadowed by the abuses of maintenance. Except for rail and plate cutting, its influence is not great except so far as it may act to accelerate the progress of failure. Battered joints cause failure of joint ties by cutting and crushing the wood. Creeping rails tend to split joint ties and to force back the spikes in or to split intermediate ties.

Summarizing, decay and mechanical damage, both of which may have their origin either before or after the ties are in the track, are the principal causes of failure in treated ties. Obviously, since the area adjacent to the rail is subjected to the greatest mechanical action, ties that are broken, cut or crushed under the rail account for the greatest number removed for mechanical reasons, although decay usually contributes to these types of failure.

Untreated ties fail in exactly the same way and for the same reasons as treated ties, although decay accounts for a larger percentage of the failures and is usually combined with every type of mechanical destruction. Most untreated ties begin to decay at the ends, while decay in treated ties generally appears under the rail or at other points of damage away from the end. Spiking and regaging have much to do with the failure of untreated ties. Splitting at the ends is another form of failure that is quite common.

In treated ties, decay generally appears first under the shell of treated wood and often is not readily apparent until it has progressed to the point of failure. In untreated ties, decay usually starts on the surface and progresses toward the interior. In either case, it is indicated first by a discoloration and darkening of the wood.

Most Failures Occur Under Rail or Tie Plates

By H. R. DUNCAN

Superintendent of Timber Preservation, Chicago, Burlington & Quincy, Galesburg, Ill.

Treated ties fail from several causes. My observation leads me to believe that much the greater number of failures occur under the rail or tie plate. In the past this could generally be traced to the fact that tie plates were not used or, if used, were too small to offer real protection. Again, until recently, ties were not adzed and bored prior to treatment, with the result that when the spikes were driven, they penetrated into the untreated wood. After they had been redriven two or three times to gage the rail or for other reasons, or after some plate or rail cutting, there was sufficient destruction of the wood fibres to permit the holding of water that entered, thus setting up conditions favorable for the development of decay. As decay increased, the cutting action of the rail or tie plate was accelerated.

I have heard some authorities express the belief that the only reason why ties fail is because they are destroyed by mechanical action. After inspecting many thousands of failed ties, I am convinced that ties fail under the rail area from a combination of decay and mechanical destruction. Possibly the mechanical damage occurs first, but it is doubtless greatly accelerated by the decay as soon as it becomes a factor.

I have observed also that a relatively small percentage of failures in treated ties have resulted from checking. Checking that is extensive enough to expose untreated wood introduces decay, with resultant ultimate failure from the latter cause, although the checking was the primary cause. I have also observed a few cases of failure from decay in which infection occurred before treatment and an insufficient quantity of preservative was used in the treatment.

Practically all of the untreated ties that I have seen removed from track, except those damaged by derailments, had failed by reason of decay. Decay in these ties generally occurs under the rail, but may be observed in any part of the tie. Occasionally, untreated ties are broken under the rail, but, except for a negligible number, decay in the area under the rail is the primary cause of failure.

Decay in either treated or untreated ties is generally indicated by dark discoloration of the decayed area, but it is more frequently detected by reason of the disintegration of the wood or by excessive plate or rail cutting, these being the usual accompaniments of decay.

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Painting Interiors

What precautions should be observed to protect patrons and employees when painting the interiors of stations and offices? How can interference with the use of these buildings be minimized?

Tries to Avoid Working During Rush Hours

By H. J. BARKLEY

Bridge and Building Foreman, Illinois Central, Carbondale, Ill.

I have always found the public willing to co-operate with us when the general movement of traffic must be diverted or interrupted temporarily by painters, provided they are forewarned properly. To avoid the probability that they will come in contact with fresh paint, we place signs at all entrances and place barricades to keep them moving through safe lanes, with signs to direct the movement. If necessary, we also assign one or two men to help direct the movement during busy periods.

In a busy station, jams can be created quite easily if good judgment is not exercised in providing the routing and directing the movement. Where this is likely to be a factor it can often be avoided by rearranging the periods of work so that the painting will be suspended during the rush hours.

Doors should be blocked open unless the weather prevents. Drop cloths should be provided, not only to protect the public in stations but employees and furniture as well in both offices and stations. In painting offices, it

is usually practicable to have private rooms and sections of general rooms vacated temporarily while the painting is in progress. Where this cannot be done, it may be necessary to carry on the painting at night.

Every Building an Individual Problem

By E. C. NEVILLE
Bridge and Building Master, Canadian National, Toronto, Ont.

Protection of patrons and employees while painting the interior of stations and offices is most important; yet the problem is not difficult except in special cases, such as large terminals having high domes or fancy ceilings, in which event elaborate scaffolding is required. Even in cases of this kind, however, one can usually arrange to do the cleaning and painting without undue interference with traffic or inconvenience to patrons, provided a close preliminary study of the conditions is made and a definite plan is prepared in advance.

Every building presents an individual problem, although for many buildings those details which must be given special consideration do not vary greatly. The size and shape of the room, whether square, oblong, angular or containing nooks, influence the style and amount of scaffolding. The height of the ceiling, the use to which the room is put, the number of employees, the volume of traffic, the kind and amount of furniture and the equipment are all factors that must be taken into account in determining the method of doing the work.

Some large terminal stations are so arranged that incoming and outgoing traffic are segregated, thus reducing the volume at given points during the rush periods. Furthermore, there are generally other periods during the day when few or no trains arrive or depart and only a few patrons are to be protected. During such periods, simple barriers to prevent too near an approach to the scaffolding should afford ample protection.

As mentioned, the selection of the scaffolding is so largely a local problem that general rules may not apply. Usually, however, a light, strong "tower" scaffold mounted on wheels or heavy castors will be most convenient and well adapted for waiting rooms with high ceilings.

This tower should have a solid deck about 10 or 12 ft. square, covered with drop cloths, which should be carried several feet beyond the edges to catch any spattering drops that may fall from the brushes. This platform is amply large to accommodate two painters, and one man stationed on the floor can wheel it around as needed without disturbing the workmen on the deck. The bracing should be high enough to pass over the tops of the station seats, thus avoiding the necessity for moving them.

In smaller stations the problem is simplier, since the rooms are generally smaller and have lower ceilings, traffic is lighter and there are usually longer periods between trains, during which time there are fewer patrons to be cared for. Here light painters' horses, trestles or ladder scaffolds, all of which can be shifted with little effort may be sufficient.

Often the painting of offices and the protection of the office force presents problems more difficult of solution than the larger station jobs. Usually, however, with reasonable ingenuity and the liberal use of painters' sheets, or drop cloths, this can be accomplished with only minor interference with business or inconvenience to employees. Occasionally, in very busy offices, especially where space is at a premium, and particularly where spray guns are to be used, it may be necessary or more economical to do the painting after office hours, even if overtime rates must be paid.

Repairing Stone Boxes

When repairing stone boxes, what methods can be used in replacing cap stones that have failed? Can the repairs be made with concrete? If so, how?

Concrete Is Suitable for Replacements

By A. C. IRWIN
Manager, Railways Bureau, Portland Cement Association, Chicago

In considering this question it is assumed that traffic must be maintained, in which case concrete slabs offer the most satisfactory solution to the problem. Suitable material for cap stones is not available in many localities and when it is, selection as to thickness and other dimensions may be limited. In most cases, therefore, precast concrete slabs will be cheaper, while they can be made of any desired dimensions. A small amount of reinforcing will insure the required strength and will generally cost less than the extra thickness of concrete in a plain slab necessary to provide the required strength. The bridge engineer can quickly draw up a table of slab thickness and reinforcement for all spans and all depths of embankments. Precast slabs can be prepared during the winter and be properly cured by the time they are to be installed.

Side walls should be leveled up with a relatively dry mortar, one that is stiffer than that used by bricklayers, in fact, one that can be balled in the hand with difficulty. Loads may be put on slabs immediately if they are bedded in this manner. Repairs to side walls can also be made with precast slabs of proper dimensions to form a given length of side wall. If the box is of sufficient size, an easy solution of this problem can be obtained by inserting a concrete pipe through the opening. Such pipes have high hydraulic capacity.

Replacing Cap Stones Is Often Difficult

By H. M. BAKER
Assistant Bridge and Building Supervisor, Missouri Pacific, Poplar Bluff, Mo.

Stone boxes and culverts were constructed by many railways as late as 1903, and there are not a few still in service that were built as long as 75 years ago. In general, the walls were laid with heavy stones, frequently on bed rock. Cap stones were used, varying up to 1 ft. or more in thickness and up to 3 ft. wide. The span ranges up to 6 ft. These boxes are found under embankments as high as 100 ft. While failure of the side walls is not uncommon, in many cases the indication of failure is first noticed in the cap stones located directly under the track. Complete replacement of stone boxes through high fills is usually so expensive that it should be avoided if it is possible to repair the structure satisfactorily. Yet, in many cases, repairs are difficult to make and the cost is disquieting.

In my experience I have found that where the cover is not more than 15 ft., it is more economical to run a trench, shoring the sides, and replace the cap stones in the open. With this method, replacement with reinforced concrete slabs becomes the easiest and most satisfactory solution. After a reasonable time for setting, say 36 hr., the trench can be backfilled, but the forms should be allowed to remain for several days.

In making similar repairs to structures under higher embankments, I have found it advantageous and no more expensive than any alternate method of which I know, to run a tunnel over the top of the box and complete the replacement of the cap stone in the manner already de-

scribed. If a large section of the box is affected, the tunnel should be considerably larger in cross section than where only one or two cap stones are involved. In the latter case, it can be enlarged directly over the damaged stones. If the sidewalls are also breaking down, the repairs can be made to better advantage from the inside of the box, provided it is wide and high enough to provide working room.

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Preparing for Spring Floods

What steps can be taken during the winter to anticipate emergency conditions in water supply, caused by thawing ice and spring floods?

Advocates Eliminating Emergency Conditions

By Supervisor of Water Service

While it is untenable to say that emergencies are something that can be avoided, many of what now pass for emergencies can be eliminated by proper planning and better design, particularly in the case of water supply facilities that are affected by thawing ice and spring floods. Ice jams at intakes may completely shut off the water supply. This can sometimes be corrected by constructing a sheer boom to return the moving ice and any drift that may accompany it, to the mid-channel of streams. The same result can be accomplished by similar construction to hold back or guide drifting ice in reservoirs. These booms can be dismantled after the flood season is over and erected again late in the following winter.

Deposits of mud and sand around the ends of suction lines laid in streams are often more difficult to guard against than ice jams and sometimes they cannot be reached for removal during flood stages. Where this difficulty has been experienced, temporary intakes or suction lines should be provided prior to the flood period. A small amount of preparation will often avoid interruption to the water supply.

In large reservoirs, where the velocity of the current is low, enough ice to form a jam seldom reaches the spillway at one time. To insure an uninterrupted movement of the ice over the spillway as it arrives and thus reduce the probability of an accumulation at any time, every obstruction that might interfere with this movement should be removed before the breakup occurs.

There may be a marked change in the quality of the water during flood stages. Previously clear water may become suddenly loaded with mud or sand or both, while the variation in dissolved constituents may be comparable. No general statement of the corrective measures necessary to insure a satisfactory water at this time will apply to the wide range of conditions that occur during these periods, but ample preparation should be made to accord with local conditions.

Preparation Should Be Corrective

By C. R. KNOWLES

Superintendent Water Supply, Illinois Central, Chicago

In general, the effects of thawing ice and spring floods may be summarized under three heads: (1) Deposits of sand, mud and other debris that interfere with the proper functioning of intakes and suction lines; (2) the accumulation of ice in spillways or excessive runoff exceeding the spillway capacity; and (3) the effect of freshets on the character of the water for locomotive use.

The clogging of intakes and suction lines is probably the most serious condition encountered during spring freshets. Such facilities are affected to a limited extent by accumulations of ice, but to a much greater extent by deposits of sand, mud and drift, particularly in the South where many of the streams are subject to wide variations in the stage of the water.

Accumulation of ice in the spillway of a storage reservoir offers a certain hazard, particularly where the reservoir is fed by large streams, because of the possibility of the runoff exceeding the capacity of the spillway, unless it has been designed to carry the maximum flood. Also, reservoirs that are stocked with fish sometimes have screens erected across the spillway to prevent the escape of the fish. These screens may obstruct the movement of ice and drift and become a hazard by causing an accumulation of ice. Unless they can be kept free of ice, they should be removed in preparation for high water.

As a rule, the effect of floods is to reduce the hardness of the water, unless they follow a long period of little rainfall, in which case the hardness may be increased temporarily. There may also be a decided increase in the amount of organic matter. Matter in suspension is increased in nearly every case. These changes may be very rapid. As an example, the Galena river in Northwestern Illinois often varies as much as 24 grains of hardness in 24 hr., while the amount of suspended matter ranges from a trace to 10 lb. per 1,000 gal. of water.

Emergency conditions arising from thawing ice and spring floods can and should be anticipated, and measures taken to guard against their effects by such protection as local conditions require. The effect on the character of the water should be anticipated and preparation made to apply such corrective measures as will insure a uniform quality during the period of the flood.

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Incorrect Guard-Rail Gage

What are the indications of incorrect guard-rail gage? Can these indications be caused by other track defects? If so, what?

Indications Are Definite

By Assistant Chief Engineer

Guard-rail gage is the distance from the gage side of the frog to the running face or working side of the guard rail, and is normally 4 ft. 6⅝ in. The indications of incorrect gage are excessive wear or battering of the frog point if the gage is narrow, and of excessive wear on the working side of the guard rail if it is too wide. Generally speaking, I do not believe that other track defects develop these indications.

There Are Two Major Indications

By ROBERT WHITE

Section Foreman, Grand Trunk Western, Drayton Plains, Mich.

There are two major indications of incorrect guard-rail gage. Wide gage can be detected quickly by the marks made by the wheels on the running face of the guard rail itself; by the fact that the wheels contact heavily with the wing rail of the frog; and by the marked tendency for the spikes holding the frog, the guard rail or the running rail, to become loose. At times the spikes holding all three become loose.

Narrow gage can be detected quickly by the fact that wheel flanges are striking the point of the frog. Badly worn guard rails or frogs will cause wide guard-rail gage; battered frogs nearly always cause tight gage. Creeping rails often cause variations in the guard-rail gage, depending on the severity of this action, while they not infrequently shove the frog out of line with equivalent results. Proper applications of anti-creepers both through the turnout and for a sufficient distance either way from it will overcome this trouble, however. It is my experience that any variation in the guard rail gage of more than ⅛ in., whether wide or narrow, should be corrected at once. To insure complete accuracy, the gage should be tested frequently with a standard gage.

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What Kind of a Hammer Line?

Is manila or wire rope preferable as a hammer line for a drop pile hammer? Why? What are the proper sizes for each?

Operator Can Quickly Damage Hammer Line

By W. J. HOUSE
Bridge and Building Foreman, New Orleans & North Eastern, Poplarville, Miss.

For pile hammer lines, I prefer steel cables or wire ropes having a diameter of ¾ in. or ⅞ in. They are more durable and resist weathering better, provided they are properly cared for. If they are run in sheaves of proper size to accommodate them, they will give satisfactory service for an indefinite period. Much depends on the operator, however. If he is adept at catching the hammer on the first rebound, most of the strain that otherwise comes on the line will be eliminated. If, on the other hand, he allows the hammer to settle on the pile before picking it up, the result will be that the line will wear quickly and the strands will shortly start to break at the eye at the point of connection with the hammer.

I have never used manila rope for a drop-hammer line. I have used such rope for pile lines, but prefer wire rope for this purpose also. Because of the relatively short life of manila rope in this service and the fact that it has considerable stretch. I do not consider it satisfactory for hammer lines.

Wire Rope Better in Every Way

By L. G. BYRD
Bridge and Building Supervisor, Missouri Pacific, Poplar Bluff, Mo.

Basing my preference on long experience, I believe wire rope of the plow-steel type to be superior in every way to manila rope. For hammers weighing from 2,000 to 2,800 lb., ⅝-in. plow-steel rope is sufficient; for weights between 2,800 and 4,000 lb., ¾-in. rope should be used. The use of wire rope reduces friction to the minimum and less power is consumed; delays to the work are less and labor costs smaller since fewer changes of rope are necessary because of wear and breaking.

Any type of rope used for hoisting wears rapidly where it passes over the sheaves, both on the surface and internally, the latter being due to the movement of the strands with respect to each other as the rope is bent in passing around the pulley. Manila rope seems to suffer more severely in this respect, however, and is also subject to more service damage than wire rope at or near its connection with the hammer. Manila rope absorbs considerable water and when wet, becomes stiff and swollen, thus increasing the tendency to bind and create friction in the pulleys and over drums. In this state, when released, it retards the drop of the hammer. Because of its more rapid wear, replacements are more frequent, thus delaying the work and increasing labor costs.

Wire rope fails most frequently at or near the clamp by which it is connected to the hammer. These failures occur more often with some operators than with others, this being largely the result of allowing too much rope to wind off of the drum when the hammer is dropped. Operators should be trained to hold the friction just enough to give them a tight line at the instant the hammer srikes the pile, but not enough to retard the drop. They should then get quicker action, catching the hammer on the rebound, and raise it quickly for the next drop.

It is also safer and more economical to use wire rope for pile lines, whether the piles are of wood or concrete. Less time and labor are required to pull the line from the release drum, while the wire rope is not affected in this respect by weather conditions. Manila rope requires more labor to pull out the pile line, particularly in wet weather because of the effect that moisture has on it.

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Which Side to Lay First

When laying rail on tangents, should the line or gage side be laid first? Why? Should the outer or inner rail be laid first on curves? Why?

Lays Line Rail First

By W. RAMBO
Roadmaster, Missouri Pacific, St. Louis, Mo.

When laying on tangents, the line rail should be laid first, because the ties are lined from this rail. If irregularities in the gage are corrected in the line rail, there will be an irregular line for the ends of the ties. This will be sure to happen if the gage rail is laid first. When replacing rail on curves, it is imperative that the outer rail be laid first. The reason for this is that, owing to the difference in length between the outer and inner rails, it is necessary to insert short rails on the low side to insure that the joints will be kept properly staggered. If the inside rail is laid first, it is impracticable to keep the staggering uniform.

Objective Is to Reduce Later Maintenance

By O. K. LAWSON
Assistant Cost Engineer, Chesapeake & Ohio, Hinton, W. Va.

When laying rail, the ultimate objective is to reduce, so far as practicable, future maintenance to the minimum. This should always be kept in mind, as should the necessity for putting the track in good line and surface as soon as the rail has been laid. If the old rail is in good alinement, it is better to lay the gage side first, since the line rail can then be used for gaging, and the gage side will be in equally good alinement. If the gage is irregular, and it is never perfect, and the line side is laid first, all of the irregularities of the gage side will be reproduced on the line side, so that lining will be necessary.

On curves, the outer rail should be laid first. The ideal condition is established when every joint is exactly opposite the center of the opposite rail. It is of vital importance that this ideal be approached as nearly as practicable, since any marked departure will have a detrimental effect on future maintenance. The rails on curves

should be of the best quality and those on the high side should all be 39 ft. long. Approaching the curve, the joints on the tangent should fall at the center of the opposite rail. It is well known that if rails of the same length are used on the low side, the joints will run ahead at the rate of one inch for every degree of central angle. For this reason, if the curve is long and of relatively short radius, there will be a serious dislocation of the joints before the full length of the curve has been traversed. By laying the outer rail first, it becomes practicable to insert shorter rails at such intervals on the low side as will bring the joints in this rail close to the proper position with respect to the outer rail. The same objective can be attained by using sufficient short rails on the tangent just before the curve is reached, to throw the joints on the inner side of the curve behind those on the outer side, the amount depending on the magnitude of the central angle. This eliminates the necessity for using short rails on the curve itself.

It Makes No Difference Which Is Laid First

By A. J. OSBORNE

Retired Roadmaster, Atchison, Topeka & Santa Fe, Belen, N. M.

When laying new track, the line side should always be laid first. Before the present practice of dapping and boring ties, it was customary to use a chalk line, marked on the line end of each tie by a "fiddler," to indicate the position of the outer edge of the base of the rail. Now the spike holes serve the same purpose.

When relaying rail on tangents, I have always preferred to start on the line side and continue on this side until reaching a curve or group of switches or closing for a train. Then I dropped back and brought up the other side, continuing on this side until circumstances made it desirable to bring the first rail up even with this progress. When relaying rail, there is no particular reason why the gage side cannot be laid first. If the track is in good line and gage, as it should be, it does not matter which side is laid first. If the gage is very bad or the rail is kinked, I would not attempt to bring the new rail to snug gage, except at such points as were free from kinks or other irregularities. Thus a better line will be established in the new rail than in the old. When laying the gage side first, however, the gage should be made snug.

I believe it is a universal practice to lay the outer rail first on curves. This practice was established in the early and rather haphazard days of railroading and has merely persisted through the power of precedent. The origin of this practice is found in the difference in the length of the inner and outer rails, necessitating the use of shorter rails for the inside of the curve, to keep the joints evenly staggered. At present it is customary to calculate this difference and provide rails of the proper length, so that there is no ironclad reason of which I am aware why either side cannot be laid first with equally satisfactory results, except to save the necessity of making a closure at an inopportune time.

Lays Outer Rail First on Curves

By H. S. TALMAN

Supervisor, Chesapeake & Ohio, Thurmond, W. Va.

By laying the outer rail first on curves, it is easier to keep the joints properly spaced, since short rails can be laid on the inside whenever necessary to care for the over-run. Obviously, it is possible to calculate the difference in length between the two rails, but the average foreman has some difficulty in doing so and prefers, therefore, to lay the outer rail first. He can then judge by eye where the short rails should be inserted. Another reason that I consider important is that the outer rail is the line rail, and by laying it first the line is not disturbed by gaging since the gage can be corrected when the low side is laid.

On long tangents I would lay the gage side first, provided both lines of spikes are to be pulled. My reason for this is that the line and gage will both be correct by gaging to the line rail, and when the line rail is laid, neither will be disturbed. On the other hand, if only one line of spikes is to be pulled, I would lay the line side first. By doing this, the line will remain correct and the gaging can be done when the gage rail is laid.

Old Rail Should Be in Line

By LOUIS M. RODREK

Section Foreman, Minneapolis, St. Paul & Sault Ste. Marie, Neenah, Wis.

When rail is to be relaid on tangents, the first thing to be done is to insure that the old rail is properly lined. Rail should never be laid on track that has irregular detail line. The new rail should then be laid first on the gage side and gaged. Line and gage will then be satisfactory. Then when the line side is laid, both line and gage will be correct. If the line side is laid first, all of the irregularities in the gage will be reproduced and the line may be unsatisfactory.

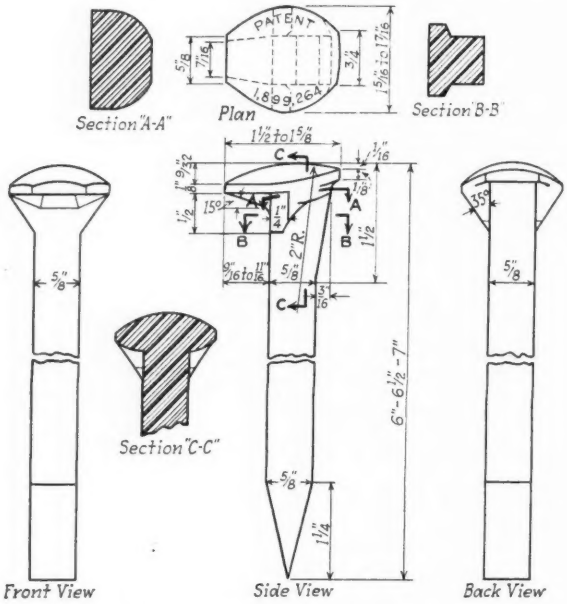
In general, the same course should be followed on curves, laying the inside or gage rail first, since the outer rail is the line rail. The difference in length of the two rails must be taken into account, however, and proper provision made for staggering the joints as nearly uniform as practicable. If the new rail is higher and has a wider base than the old rail, the outer rail should be laid first, as both the elevation and the gage will be disturbed.

Recent Widespread Heavy Snows Have Made Such Scenes as This Typical Throughout a Large Part of the Country

New Device

Spike With Reinforced Throat Offers Several Advantages

IN an effort to overcome the shortcomings of the ordinary cut track spike, a new spike has been developed, known as the Full-Throated spike, which is of essentially the same design as the standard cut spike, except for the throat, which has been reinforced through the redistribution and addition of metal in order to bring about several desirable features. The principal features of reinforcement of the throat are two angular lugs beneath the sides



Details of the New Full-Throated Track Spike

of the head and a tapered back directly beneath the head, which are intended to cause the spike to come in contact with all sides of the tie plate holes, preventing the head from being driven down flush on the plate or against the rail and holding the plate from movement with respect to the tie.

Other Features

On the commonly used 5/8-in. spikes in lengths of 6, 6½ or 7 in., the lugs or swellings on the sides of the throat are ½ in. in depth and flare out from the straight sides of the spike on an angle of 35 deg., to the outside edges of the head. These side flares are flush with the front face of the spike shaft and, back of a width of ¼ in., taper backward to the normal width of the shaft at the rear of the head. The outward or backward flare of the rear of the spike shaft is a maximum of 3/16 in., and begins 1½ in. below the top of the head. The only other important modification of the spike is that the amount of metal on the underside of the front or lip of the head has been reduced, so that both the side and rear flares extend well below the underside of the lip on the shaft of the spike.

Of such design, when driven as an anchor spike in a plate hole of proper size, the side and rear flares of the throat cause the spike to come in contact with all edges of the hole, holding the plate down securely, while the head itself is clear of the plate. When driven as a rail-holding spike in a plate with rail shoulders and holes of proper size, the side flares of the throat come in contact with the metal of the plate shoulder and thus prevent the spike from being driven to the point where the underside of the head or head lip comes in contact with the rail base. Where there is no rail shoulder, the side flares do not come into play and the head can be driven down tight on the rail.

It is important that plate holes of proper size be provided to insure the proper functioning of the full-throated spikes. These dimensions should be ¾ in. by 11/16 in. for plate-holding holes and 11/16 in. by 13/16 in. for rail-holding holes, with the following allowable manufacturing tolerances: When measured on the top (ribbed or shouldered plates) surface of the tie plate, a variation of 3/64 in. more and 1/64 in. less than the dimensions specified; when measured on the bottom surface of the plate, a variation of 0 in. more and 1/16 in. less than the dimensions specified.

Advantages Claimed

The principal advantages claimed for the spike are that it is reinforced where throat cutting by the plate and rail occurs; that the throat reinforcement will reduce the number of heads which will be broken off while pulling, with the safety factor which this affords; that the reinforcing will minimize or prevent bending of the spikes when pulling and thereby permit redriving without the necessity for straightening; that when used as a plate anchor, the spike will fill the plate hole, hold the plate down tight, prevent rattling, minimize wear of the tie and spike, and, at the same time afford a claw bar gripping hold for ready pulling; and that when used for holding the rail, the spike affords about ⅛ in. clearance between its head and the base of the rail, permitting flexure in the rail without being backed out with the necessity for redriving and the damage to the tie which this occasions.

The new spikes, which are manufactured in the same manner as ordinary cut spikes and which may be obtained in any lengths desired, are being furnished by The Rails Company, New York City.

A Creosoted Wood Tank on a Brick Substructure on the Reading at Germantown, Pa.

News of the Month . . .

Rails Net Income for 10 Months Increases 52.8 Per Cent

For the first 10 months of 1933 the Class I railroads of the United States had a net railway operating income of $398,238,658, which represented an increase of $137,622,180, or 52.8 per cent, as compared with the same period in 1932. The net income for the 1933 period represented an annual rate of return of 1.77 per cent on the property investment of these railroads, compared with a return of 1.15 per cent in the same period of the previous year. Operating revenues for the first 10 months of 1933 totalled $2,592,440,961, compared with $2,632,798,757 for the corresponding period of 1932, a decrease of 1.5 per cent.

Buses Protest Low Rail Fares

Because of recent widespread reductions in railway passenger fares, the competitive situation between the railroads and motor bus lines has been reversed and the latter have now been placed in a position where they must compete with passenger fares as low or lower than their own. As a consequence, representatives of the motor bus operators have addressed three separate communications to President Roosevelt, General Hugh S. Johnson and the Interstate Commerce Commission, in which notice has been served that the bus lines will seek release from the provisions of the code of fair competition for the motor bus industry if the administration and the commission do not take steps to "stabilize rail passenger rates at a reasonably compensatory level" and so prevent the railroads from operating at "ruinous rates designed to cripple highway transportation.

Co-ordinator Eastman Asks Views of Travelers

In an effort to determine the travelers' point of view in regard to various phases of railroad transportation, Joseph B. Eastman, federal co-ordinator of transportation, has distributed a "passenger ballot" to 200,000 representative travelers in all parts of the United States, in which the traveler is asked to vote on various questions of interest to those who are frequent users of the country's transportation facilities. Do travelers want faster rail transportation with trains, for example, that travel at speeds of 90 miles an hour? Do they want transportation so co-ordinated that one ticket will cover all agencies providing a "door to door" service? Do they want changes in present rail equipment? How do they rate the advantages of the various forms of passenger transportation? If rail fares and service were adjusted in better accord with the needs of travelers, to what extent would travel for business and pleasure be increased? The foregoing questions are representative of those contained in the "passenger ballot", which contains 24 pages, illustrated with pen-and-ink sketches.

Cars Combine Restaurant, Sleeping and Observation Facilities

A new type of railroad car in which are combined restaurant, sleeping and observation facilities has recently been placed in service on several railroads by the Pullman Company. The newest of these cars, which are considered to be of particular value in soliciting party movements because of their private car features, are in service on the Chicago, Rock Island & Pacific and the Chicago, Burlington & Quincy. The cars in service on the former road contain eight open sections, a kitchen, a dining section and an observation-lounge. An outstanding feature of the cars is that they are so equipped that either ice or mechanical air cooling can be added at any time if desired.

Floods in Northwest Cause Extensive Damage

Heavy and widespread rains in the Pacific Northwest during the week immediately preceding Christmas, caused extensive damage to railroad tracks, bridges and other property in the states of Oregon, Washington, Montana and Idaho. It is estimated that track and bridge washouts and landslides caused damage amounting to millions of dollars, while it was expected that in some instances it will not be possible to resume service over the damaged tracks for several weeks. Train service during this period was generally disorganized in the territory involved, several limited trains being stranded by the floods and landslides. One of these, the Olympian of the Chicago, Milwaukee, St. Paul & Pacific, eastbound to Chicago, was stranded on December 22 near St. Regis, Mont., with 125 passengers aboard. After spending more than a day on the marooned train, the majority of the passengers were removed to Missoula, Mont., to board another train for Chicago.

Planning Committee Suggests Five Billion for "Transportation"

A two-year program of possible expenditures amounting to $5,400,000,000 for "transportation" is suggested in an unofficial study prepared by a committee in the Division of Economic Research and Planning of the National Recovery Administration, outlining a total construction program of some 14 billion dollars, which has been transmitted to the Public Works Administration for consideration. The transportation part of the program is summarized as follows: Grade crossings and highway correction, $2,400,000,000; superhighways, $1,000,000,000; railway improvements—roadbed and other work exclusive of rolling stock—$1,500,000,000; and terminals, piers and docking facilities, $500,000,000. One premise connected with the plan seems to be that the stimulation of highway construction would create a competitive situation which would compel large additional expenditures for railway construction and at the same time widen the field for expenditures for the elimination of grade crossings.

An Economic Survey of Motor Vehicle Transportation

In an Economic Survey of Motor Vehicle Transportation in the United States, just made public by the Bureau of Railway Economics, Washington, D. C., the transportation situation in this country, with particular reference to competition, regulation and taxation, is subjected to a searching analysis. In approaching the problem of the equitable taxation of transportation agencies, the survey evolves a formula for determining the greater cost of a highway built and maintained to carry the heaviest trucks and buses, as compared with the cost of a highway carrying only the lighter vehicles. From this formula it is determined that 91 per cent of the total number of motor vehicles of all classes would pay 45 per cent of the total road budget while the remaining 9 per cent would pay 55 per cent of the budget. The survey then goes into the inequalities in the competition between motor trucks and the railroads, as manifested by intrastate but not interstate regulation of buses and trucks, the hidden costs of truck transportation which are paid by the taxpayer and not the shipper, and the difference in working hours and rates of pay.

Railroads Aid Relief of Needy by Reducing Rates

By lowering their freight rates for the transportation of surplus commodities shipped by the Federal Surplus Relief Corporation for distribution to the needy, the railroads are permitting the corporation to make more money available for the purchase of additional commodities for relief, according to Harry L. Hopkins, president of the corporation and federal emergency relief and civil works administrator. Mr. Hopkins estimated that the savings thus made might run as high as $5,000,000. "Accomplishment of the two-fold purposes of the Federal Surplus Relief Corporation, first to relieve distress, and second, to absorb the nation's surplus commodities, requires that the greatest economy be practiced in order to reach the many thousands in need," said Mr. Hopkins. "It is recognized that the carriers in the last few years have suffered reduced earnings, as have the people, but the care of helpless and needy people is paramount to the matter of earnings. By granting a reduction in rates, the carriers are giving impetus to the relief of unemployment hardships for which the President and the people are so earnestly striving."

Association News

Metropolitan Track Supervisors' Club

The last meeting of the club was held on December 14, at Keen's Chop House, 72 West Thirty-sixth street, New York City, following luncheon which was served at 1 p. m. The two principal features of the meeting were a paper on "Track-Walkers" by W. H. Haggerty, supervisor, New York, New Haven & Hartford, and a paper on "Rail and Flange Lubrication," by D. M. Clarke, service engineer, Maintenance Equipment Company.

Maintenance of Way Club of Chicago

C. W. Baldridge, assistant engineer, Atchison, Topeka & Santa Fe., was the speaker at the meeting on Wednesday evening, December 20, his subject being "How Rail Allotments Are Made." After directing attention to measures for restoring the surface at the joints, which have reduced the demand for rail replacements, Mr. Baldridge discussed the various factors that must be taken into account in determining the allotment of new rails. He also presented a list of physical conditions that should be noted in the course of an inspection to study the need of rail renewals.

The next meeting will be held on Wednesday evening, January 17.

American Railway Engineering Association

The reports of all of the standing and special committees except four, are in the hands of the secretary, and these are expected within the next few days. The reports of seven of the committees and the report of the Electrical section of the A.R.A. have been printed and mailed to the members of the association in three bulletins. The largest of these, a book of 308 pages, contains the report of the Special Committee on Stresses in Railroad Track. A fourth bulletin is now on the press and will be mailed during the first week in January, while the fifth will be mailed a few days later.

Only one committee, that on Iron and Steel Structures, held a meeting during December, this being at Pittsburgh, Pa., on December 7, with an attendance of 18. The meeting of the Committee on Rail which was scheduled for December, was postponed until January 4, on which date it will be held at Chicago.

Wood-Preservers Association

Plans for the thirtieth annual convention at Houston, Tex., on January 23-25, are approaching completion. In addition to the reports of committees on Service Records of Ties, Bridge and Structural Timber, Marine Piling and Poles, on Preservatives and on Pressure and on Non-Pressure Treatment, addresses will be presented on the use of treated timber in marine structures, by J. F. Coleman, consulting engineer, New Orleans, La.; on foundation piling, by J. R. Cummins, consulting engineer, Houston, Tex.; on treated poles, by R. E. Meyers of the International Creosoting & Construction Company, Galveston, Tex., and on new uses for treated material, by Dr. Hermann Von Schrenk, consulting timber engineer, St. Louis, Mo. In addition, numerous papers and reports will be presented on the more technical phases of the seasoning and treatment of timber.

Arrangements are being made for those traveling to the convention to gather at St. Louis, Mo., on Saturday evening, January 20, for movement to Houston via the Missouri Pacific, the Texas & Pacific and the Atchison, Topeka & Santa Fe., stopping enroute to visit the treating plants of the Ayer & Lord Tie Company at Little Rock, Ark., of the International Creosoting & Construction Company and of the National Lumber & Creosoting Company at Texarkana, and the treating plant of the Santa Fe Railway at Somerville, Tex., reaching Houston Monday evening. Plans are being made also for connecting cars from New York and Chicago to join the party at St. Louis and for a car from Kansas City to join the party at Little Rock. R. S. Belcher, manager treating plants, A. T. & S. F. railway, is president of this association.

Railroads to Restrict the Riding of Freight Trains

Beginning on January 1 the railroads commenced to impose stringent restrictions against the stealing of rides on freight trains by the "transient unemployed." These restrictions were placed in effect at the request of, and in co-operation with, Harry L. Hopkins, federal emergency relief administrator, who announced that the move was being made in conection with the campaign of the relief administration to help the transients settle down. For this purpose the relief administration has established a nation-wide net-work of about 200 centers for the care of the unemployed.

I. C. C. to Investigate Store-Door Service in Southwest

The Interstate Commerce Commission has undertaken an investigation of the free pick-up and delivery service by truck which was established on March 29, 1932, by the St. Louis Southwestern and later by other railroads in the Southwest. The latter railroads, which had opposed the new service petitioned for a rehearing of the question and the commission assented in order to determine whether the practices are in violation of the law or are consistent with honest, efficient and economical management. "There is grave doubt," said the commission, "as to whether the traffic gained by this new arrangement is sufficient to pay the expense of maintaining the service. As stated above, protestants have established similar service in the general territory here considered. Their position is that they were forced to establish the service, that it is expensive, does not add enough traffic to pay for its maintenance, and that it is not so policed as to prevent discriminations in violation of the act."

Personal Mention

General

H. C. Aquilar, roadmaster on the Kansas City, Mexico & Orient, of Mexico, with headquarters at Ciudad Juarez, Chih., has been promoted to superintendent of the Chihuahua and Mountain divisions, with the same headquarters.

A. E. Kriesien, assistant division engineer on the New York division of the Erie, with headquarters at Jersey City, N. J., has been appointed transportation inspector in the operating department, with headquarters at Cleveland, Ohio.

George J. Ray, chief engineer of the Delaware, Lackawanna & Western, has been promoted to vice-president and general manager, with headquarters at New York, effective January 1. Mr. Ray was born at Metamora, Ill., on March 24, 1876. He was graduated from the Uni-

George J. Ray

versity of Illinois in 1898 with the degree of bachelor of science and in 1910 received the degree of civil engineer from the same university. He began his railroad career in May, 1898, as a chainman on the Illinois Central, subsequently serving consecutively as a rodman, inspector, instrument man and assistant engineer. From March, 1901, to March, 1902, Mr. Ray served as supervisor of track, then serving for a year as a roadmaster. In 1903 he entered the service of the Delaware, Lackawanna & Western as division engineer at Scranton, Pa. From September, 1908, to January, 1909, he served with T. Burke, railroad contractor, at Scranton, Pa., returning to the service of the Lackawanna on the latter date as chief engineer. Mr. Ray served as engineering assistant to the regional director of the Eastern region of the United States Railroad Administration for two years during the period of federal control, then resuming his position as chief engineer of the Lackawanna, the position he held at the time of his recent promotion. Mr. Ray is a past president of the A.R.E.A. and has been active in the work of that organization for many years.

We wish to extend

to all our

friends

and

customers

A Happy New Year

WOODINGS FORGE & TOOL CO.
WOODINGS-VERONA TOOL WORKS

VERONA . . . . . PENNA.

Engineering

Robert Farnham, chief engineer in charge of the Philadelphia improvements of the Pennsylvania, has been transferred to the staff of the chief engineer.

D. E. Woozley, engineer maintenance of way of the Union Railroad, with headquarters at East Pittsburgh, Pa., has been appointed to the newly-created position of chief engineer, with the same headquarters. **S. S. McGregor** has been appointed engineer of track and **A. L. Lee** has been appointed engineer of bridges.

J. A. MacKenzie, roadmaster on the Canadian Pacific, with headquarters at Guelph, Ont., has been promoted to division engineer of the Trenton division, at Toronto, Ont., to succeed **W. C. E. Robinson,** who has been transferred to the Laurentian division, with headquarters at Montreal, Que. Mr. Robinson succeeds **W. B. Harper,** who has been transferred to the Montreal Terminals division, at Montreal, replacing **John R. Caswell,** who has been transferred to the Smiths Falls division, with headquarters at Smiths Falls, Ont. Mr. Caswell succeeds **W. W. Benny,** who goes to the Schreiber division, at Schreiber, Ont., to replace **J. A. Irvine,** who has been transferred to the Sudbury division at Sudbury, Ont. Mr. Irvine takes the place of **J. M. Silliman.**

In a general shift of division engineers on the Erie, **Blair Blowers,** has been transferred from the Susquehanna, Delaware and Tioga divisions, with headquarters at Hornell, N. Y., to the New York division, including the New Jersey & New York Railroad, with headquarters at Jersey City, N. J., succeeding **F. S. Wheeler,** who has been transferred to the Mahoning division, with headquarters at Youngstown, Ohio, to replace **Paul Sabbott.** Mr. Sabbott has been transferred to the Wyoming and Jefferson divisions, including the Wilkes-Barre Railroad, with headquarters at Dunmore, Pa., where he succeeds **G. E. Righter,** who has been moved to the Buffalo and Rochester divisions, including the Bath & Hammondsport Railroad, with headquarters at Buffalo, N. Y. Mr. Righter relieves **R. L. Dyke,** who has been moved to the Marion division, with headquarters at Huntington, Ind., to take the place of **H. J. Weccheider,** who had been moved to the Susquehanna division, at Hornell, to take the place of **Blair Blowers. H. H. Clark,** track supervisor on Subdivision 1, with headquarters at Hackensack, N. J., has been appointed assistant division engineer on the Buffalo and Rochester divisions, with headquarters at Buffalo, succeeding **F. J. Haagen,** who has been transferred to the New York division, with headquarters at Jersey City. Mr. Haagen succeeds **A. E. Kriesien,** whose transfer to the operating department, at Cleveland, Ohio, is noted elsewhere in these columns.

Track

F. F. Mallon, formerly a roadmaster on the Oregon-Washington Railroad & Navigation Company, with headquarters at Portland, Ore., has been re-appointed to that position, to succeed **C. A. Smith,** who has been transferred to the La Grande district, with headquarters at La Grande, Ore., where he succeeds **N. C. Pearson,** who has been granted a leave of absence.

E. A. Kelly has been appointed temporary roadmaster on the Canadian Pacific, with headquarters at Aldersyde, Alta., succeeding **R. F. P. Bowman,** who has been transferred to Lethbridge, Ont., where he replaces **J. H. Soans,** whose appointment as acting bridge and building master is noted elsewhere on this page, under Bridge and Building.

W. E. Stenson has been appointed supervisor of Subdivision 1, Buffalo and Rochester division of the Erie, with headquarters at Buffalo, N. Y., to succeed **W. L. Kelly,** who has been transferred to Subdivision 1 of the New York division, with headquarters at Paterson, N. J., to relieve **J. R. MacAsy.** Mr. MacAsy has been transferred to the Greenwood Lake division and Newark branch, with headquarters at North Newark, N. J., to replace **T. J. Leonard,** who has become supervisor on the Northern Railroad of New Jersey, the N. J. & N. Y. Railroad, and the Piermont branch, with headquarters at Fairmount avenue, Hackensack, N. J. Mr. Leonard succeeds **J. J. Joyce,** who has been transferred to Subdivision 1, with headquarters at Main street, Hackensack. Mr. Joyce replaces **H. H. Clark,** whose promotion to assistant division engineer is noted elsewhere in these columns. **C. J. Foglegren,** supervisor Subdivision 1, Marion division, with headquarters at Lima, Ohio, has been transferred to Subdivision 3 of the Kent division, with headquarters at Marion, Ohio, to succeed **B. R. Perfect,** who has been transferred to Subdivision 3 of the Mahoning division, with headquarters at Greenville, Pa. Mr. Perfect relieves **G. A. Johnson,** who has been assigned to other duties. **W. H. Leatherman,** supervisor at Decatur, Ind., has been transferred to Subdivision 1 of the Marion division, with headquarters at Lima, Ohio, to succeed **C. J. Foglegren. L. E. Rodgers,** section foreman at Hammond, Ind., has been appointed supervisor on the Rochester division and Attica branch, succeeding **J. H. Thomas,** who has become supervisor on the Wyoming division, at Dunmore, Pa., to take the place of **F. B. Bisbing,** deceased.

Bridge and Building

W. J. Lacy, supervisor of bridges and buildings on the Missouri Pacific at Murphysboro, Ill., has been transferred to St. Louis, Mo., succeeding **M. Paffrath.**

L. H. Ramer, assistant master carpenter on the Alleghany, Bradford, Meadville and B. & S. W. divisions of the Erie, with headquarters at Salamanca, N. Y., has been assigned to other duties. Mr. Ramer's former position has been abolished.

D. E. Wiltse, in the chief engineer's office of the Pennsylvania, has been appointed master carpenter of the Delmarva division, with headquarters at Cape Charles, Va., succeeding **J. J. Caldwell,** who has been transferred to the Wilkes-Barre division. **J. S. Binkley, acting master carpenter** on the Philadelphia division, with headquarters at Philadelphia, has been appointed master carpenter on the Williamsport division, with headquarters at Williamsport, Pa., succeeding **T. T. Lowdermilk,** whose death was noted in the December issue.

J. H. Soans, roadmaster on the Canadian Pacific at Lethbridge, Alta., has been appointed acting bridge and building master, with the same headquarters, replacing **L. Wade,** who has been granted an extended leave of absence because of ill health.

L. B. McAllister, a general foreman on the Southern Pacific at Sacramento, Cal., has been promoted to supervisor of bridges and buildings on the San Diego & Arizona Eastern (a subsidiary of the Southern Pacific) at San Diego, Cal., to succeed **Fred Armstrong,** who has been transferred to Bakersfield, Cal., on the Southern Pacific. Mr. Armstrong replaces **W. C. Harman,** who has been transferred to San Francisco, Cal., to succeed **P. N. Nelson,** who has retired, after 40 years of service with the Southern Pacific.

Obituary

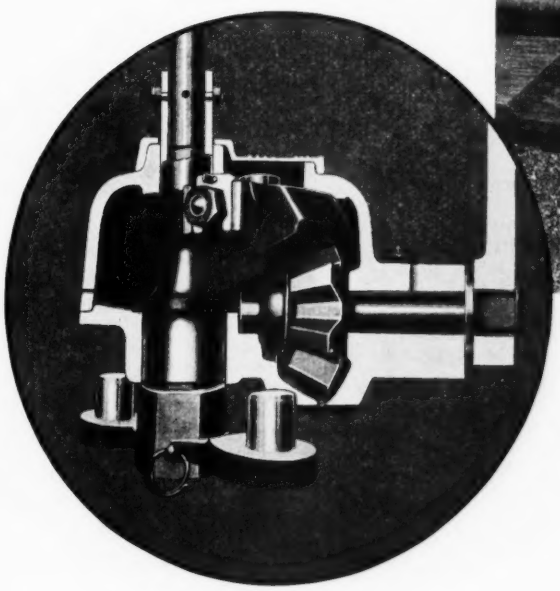
A. J. Sorenson, roadmaster on the Chicago & North Western, with headquarters at Huron, S. D., died on December 26, of heart disease.

L. H. Porter, who retired in 1908 as a supervisor on the New York, New Haven & Hartford, died on October 10 at Willimantic, Conn., following a short illness.

Michael Riney, who retired in 1921 as supervisor of bridges and buildings on the Chicago & North Western, died on December 5 at his home at Baraboo, Wis., at the age of 82 years. A native of Ireland, Mr. Riney was brought to this country at the age of two years. Before entering the service of the North Western in 1894, he was engaged in the construction of a number of large bridges, both railroad and vehicular. During his early career he was with the Leighton Bridge & Iron Works and while with this company he was connected with the construction of the double-track bridge of the Boston & Maine across the Connecticut river at Springfield, Mass. Thereafter he was actively engaged in a wide variety of construction projects, usually in a supervisory capacity, ranging from the construction of the Second Avenue elevated extension in New York to the reroofing of the James J. Hill residence at St. Paul, Minn. During his entire span of service with the North Western, Mr. Riney served as supervisor of bridges and buildings of the Madison division, with headquarters at Baraboo.

George E. Tebbetts, engineer of structures for the Chicago Rapid Transit Company, and formerly bridge engineer of the Kansas City Terminal, died on December 13 at St. Luke's hospital, Chicago. Mr. Tebbetts was born on March 6, 1877, at Chicago, and graduated in civil engineering from the University of Illinois. In June, 1899, he first entered railway service as a rodman on the Chicago Junction, leaving this company in November

A *Rugged* Switch Stand



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2. Selective adjustment by means of small shims. Each switch point can be independently adjusted without disengaging stand or disturbing connecting rod.
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5. Drop-forged and heat-treated alloy-steel parts.
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7. All parts of all stands are interchangeable, and carried in stock for immediate shipment. Your present New Century Switch Stands may easily be brought up-to-date by purchasing new parts.

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Here is a stand with parts made from heat-treated alloy-steel forgings. A stand that easily throws your heaviest, reinforced switch, and that won't overturn. Either switch point can be quickly adjusted without disconnecting the stand from the switch. If parts are ever needed you can get them quickly and without trouble.

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New Century Switch Stand

of the same year to engage in other work. He returned to railway service in 1902 as a draftsman in the bridge department of the Chicago, Milwaukee, St. Paul & Pacific, resigning in the following year to go with Fairbanks, Morse & Co., as a designer. After serving in a similar capacity with the Link Belt Company, Mr. Tebbetts entered the bridge department of the Chicago, Burlington & Quincy in

George E. Tebbetts

1904, subsequently being advanced to office engineer. In 1910 he became bridge engineer of the Kansas City Terminal, which position he held until 1918, then serving successively with the Emergency Fleet Corporation, the York Shipbuilding Corporation, Stone & Webster, Inc., the Roberts & Schaefer Co. and the Detroit Graphite Company. In 1923 he was appointed general supervisor of bridges and buildings of the Chesapeake & Ohio at Richmond, Va., holding this position until 1925 when he went with the Chicago Rapid Transit Company is engineer of structures.

Portable Air Compressor.—The Worthington Pump & Machinery Corporation, Harrison, N. J., has issued an illustrated folder describing this company's 120-cu. ft. portable air compressor.

Valves and Fittings for Railroads—The Crane Company, Chicago, has issued an illustrated catalog, designated as Circular No. 300, in which is given a complete list of the various valves and fittings manufactured by this company.

Toncan Iron Pipe for Permanence—The Republic Steel Corporation, Youngstown, Ohio, has published a 64-page attractively printed and illustrated booklet bearing this title which contains complete information regarding Toncan iron pipe. The booklet is divided into two major parts. Part I, entitled Technical Data and Tests, outlines the development of Toncan copper molybdenum iron, gives its advantages as a pipe material, shows the results of tests designed to determine the resistance of this metal to various destructive agencies, and discusses its welding properties. Part II, entitled Installations and Service Records, contains a list and many illustrations of the buildings, plants and other projects in which Toncan iron has been employed in some manner.

Supply Trade News

Personal

Edward J. and **George T. Henggi,** of Oakmont, Pa., announce the formation of the **Henggi Rail Anchor Company** at Oakmont, for the purpose of marketing the Henggi rail anti-creeper.

H. Ross Poulson has been appointed sales engineer in the Transportation and Government department of the **Johns-Manville Sales Corporation,** with headquarters at Chicago. Mr. Poulson was formerly associated with Johns-Manville.

W. A. Nugent has been appointed sales manager of the **Independent Pneumatic Tool Company,** Chicago. Mr. Nugent, who was district manager of the Chicago territory at the time of his recent appointment, has been with the company 19 years and during this period has served as branch manager at St. Louis, Mo., as assistant to the president and in other capacities. He assumed his new duties on December 1.

William J. Filbert, vice-chairman of the Finance committee of the **United States Steel Corporation,** has been elected chairman of the Finance committee to succeed **Myron C. Taylor,** who will continue in his other offices as chairman of the board of directors and chief executive officer. The Finance committee has selected **Edward R. Stettinius, Jr.,** vice-president of General Motors Corporation, as its vice-chairman, to replace Mr. Filbert. Mr. Filbert will assume his new position on January 1, while the appointment of Mr. Stettinius does not become effective until April 1, 1934.

Mr. Filbert was born at Palatine, Ill., and began his business career in 1881, as a clerk in the purchasing department of the Chicago & North Western at Chicago. He later entered the accounting department of that road, attaining the position of chief accountant before he left in 1898, to become assistant auditor and shortly thereafter auditor of the Federal Steel Company. This company was merged with others in 1901 to form the United States Steel Corporation and after this formation Mr. Filbert became assistant controller, serving in that capacity until June, 1902, when he was made controller. Since January 26, 1932, he has served as vice-chairman of the Finance committee. He has been a director of the corporation since December, 1919, and a member of the Finance committee since April, 1922. Mr. Filbert was the first secretary of the American Iron and Steel Institute, and in 1931, was honored by that body when he was awarded the Gary Memorial Medal for outstanding service in the interest of the institute.

Mr. Stettinius was born on October 22, 1900, at Chicago, Ill., and was educated at the University of Virginia. He entered the service of General Motors in 1924, through the Hyatt Roller Bearing Company. In 1926, he was appointed assistant to the vice-president of General Motors, and in 1930, became assistant to the president. In May, 1931, he was elected vice-president. He is also a director and vice-president of General Aviation Corporation; a director and member of the executive committee of North American Aviation, Inc., and of Transcontinental and Western Air Express, Inc., and a director of Eastern Air Transport. In June, 1933, he was appointed liaison officer between the Industrial Advisory Board and the National Industrial Recovery Administration, and has been in Washington for the last six months in that capacity.

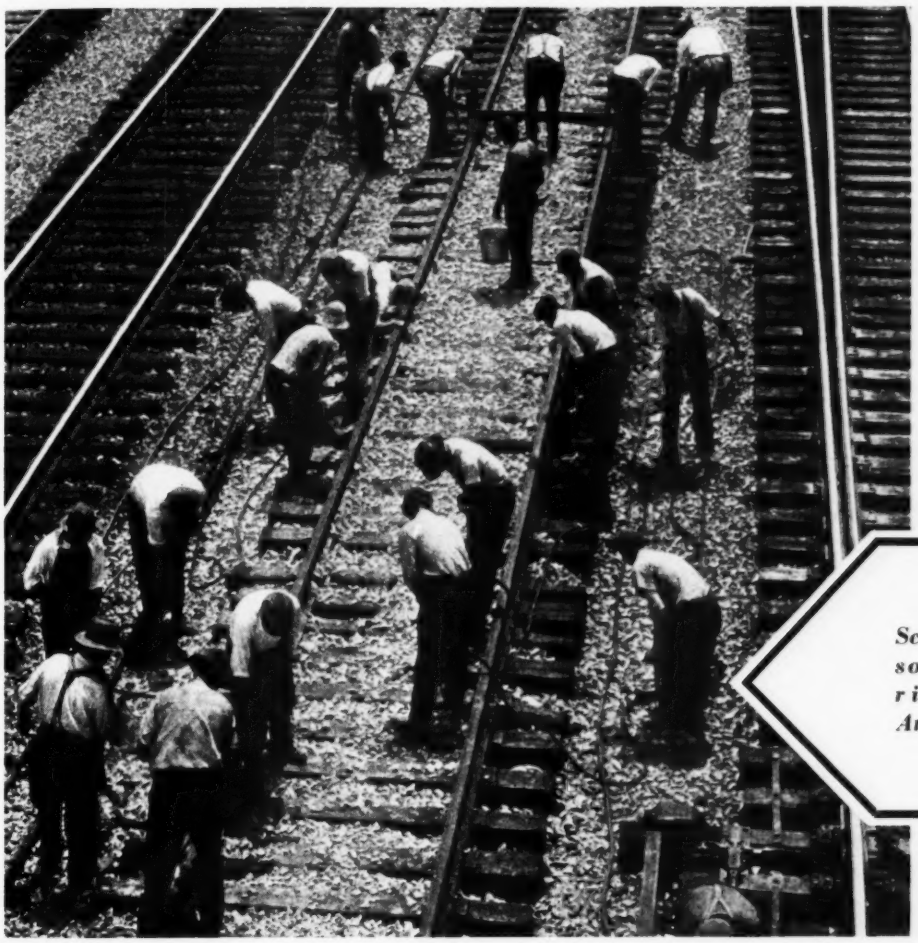
Obituary

Arthur A. Brown, assistant to vice-president, Westinghouse Electric & Manufacturing Company, died at his home at Mt. Vernon, N. Y., on December 19.

Calvert Townley, formerly a vice-president of the Westinghouse Electric & Manufacturing Company, died suddenly of a heart attack, on November 27 in New York, in his seventieth year. A graduate of the Sheffield Scientific School of Yale University, Mr. Townley became identified with the Westinghouse Electric & Manufacturing Company at the age of 23, and remained with that organization, with the exception of a short period, until his retirement. During his service with the company he became interested in a large number of utility corporations and in 1904 he left the Westinghouse Company to participate in the management of his utility interests. Until 1911 he was consulting engineer for the New York, New Haven & Hartford in planning the electrification of railroad lines leading out of New York. He later returned to the Westinghouse Company as vice-president and assistant to the president.

Herbert T. Herr, vice-president of the Westinghouse Electric & Manufacturing Company, died at his home in Philadelphia, Pa., on December 19. Mr. Herr was born on March 19, 1876, at Denver, Colo., and was graduated from the Sheffield Scientific School of Yale University in 1899. After graduation he served two years as a machinist and draftsman on the Denver & Rio Grande (now the Denver & Rio Grande Western). In 1902 he served as a master mechanic on the Chicago Great Western, then on the Atchison, Topeka & Santa Fe, and later as general master mechanic of the Eastern division of the Norfolk & Western. He returned later to the Denver & Rio Grande as assistant to the vice-president, becoming general superintendent in 1906. Soon afterward he retired from railroad work and in 1908 he went to Pittsburgh, Pa., as general manager of the Westinghouse Machine Company. Shortly thereafter, he was promoted to second vice-president and general manager, and in 1913, became first vice-president and general manager. When this company was merged in 1917 with the Westinghouse Electric & Manufacturing Company he became vice-president of the latter and continued in that capacity until the time of his death.

BUSINESS IS NO LONGER "AROUND THE CORNER"—IT IS HERE



Scenes such as this will soon again dot the right of ways of America's railways.

Within recent weeks, 24 railways have ordered or will soon complete arrangements to purchase nearly a half-million tons of rails.

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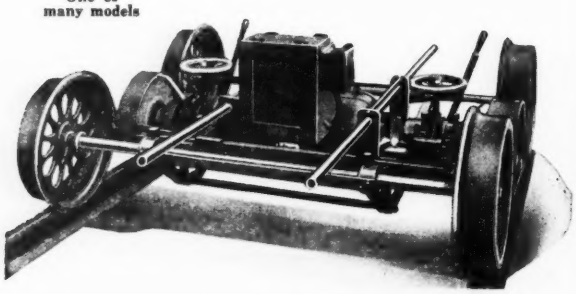

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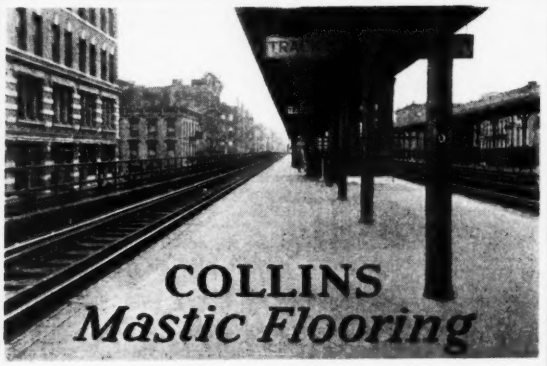

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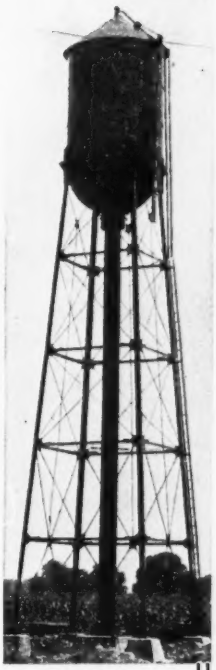

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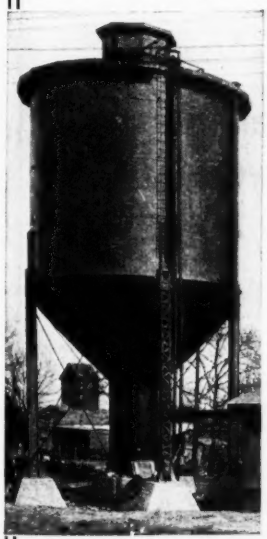

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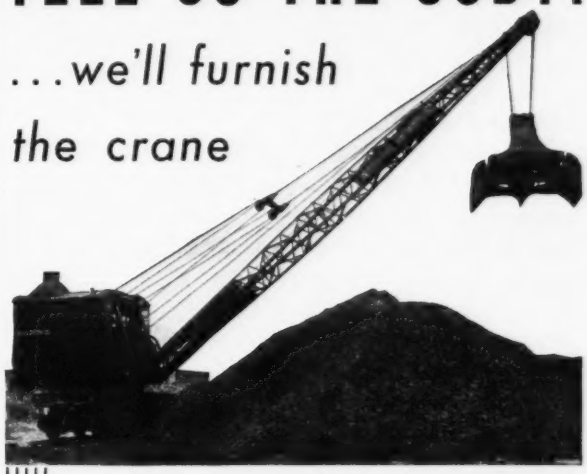

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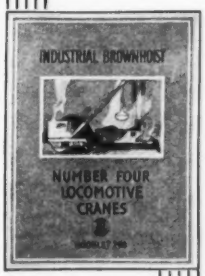

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What a HIT this POWER WRENCH has made

One man operation. Rides through switches and crossings. Swinging wrench arm reaches nuts at inside or outside of rail.

A Prominent Road Orders 12 POWER WRENCHES

With twelve Nordberg Power Wrenches periodically tightening all joints over the entire system, the problem of loose joints was solved. This machine affords the cheapest possible means of maintaining joints of uniform tightness.

Periodic tightening prevents damage to new rail and injury to old rail caused by end batter and chipping, largely traceable to loose joints. No other track maintenance machine developed by Nordberg has attracted more attention. It is the answer to that most annoying track problem.

Here are the other tools Nordberg designed to fit your track jobs. Are you planning on laying rail next year? If so, make them a part of your program.

Spike Puller
Adzing Machine
Power Jack
Cross Grinder
Rail Grinder
Rail Drill
Track Shifter

Railway Equipment Dept.

NORDBERG MFG. CO.
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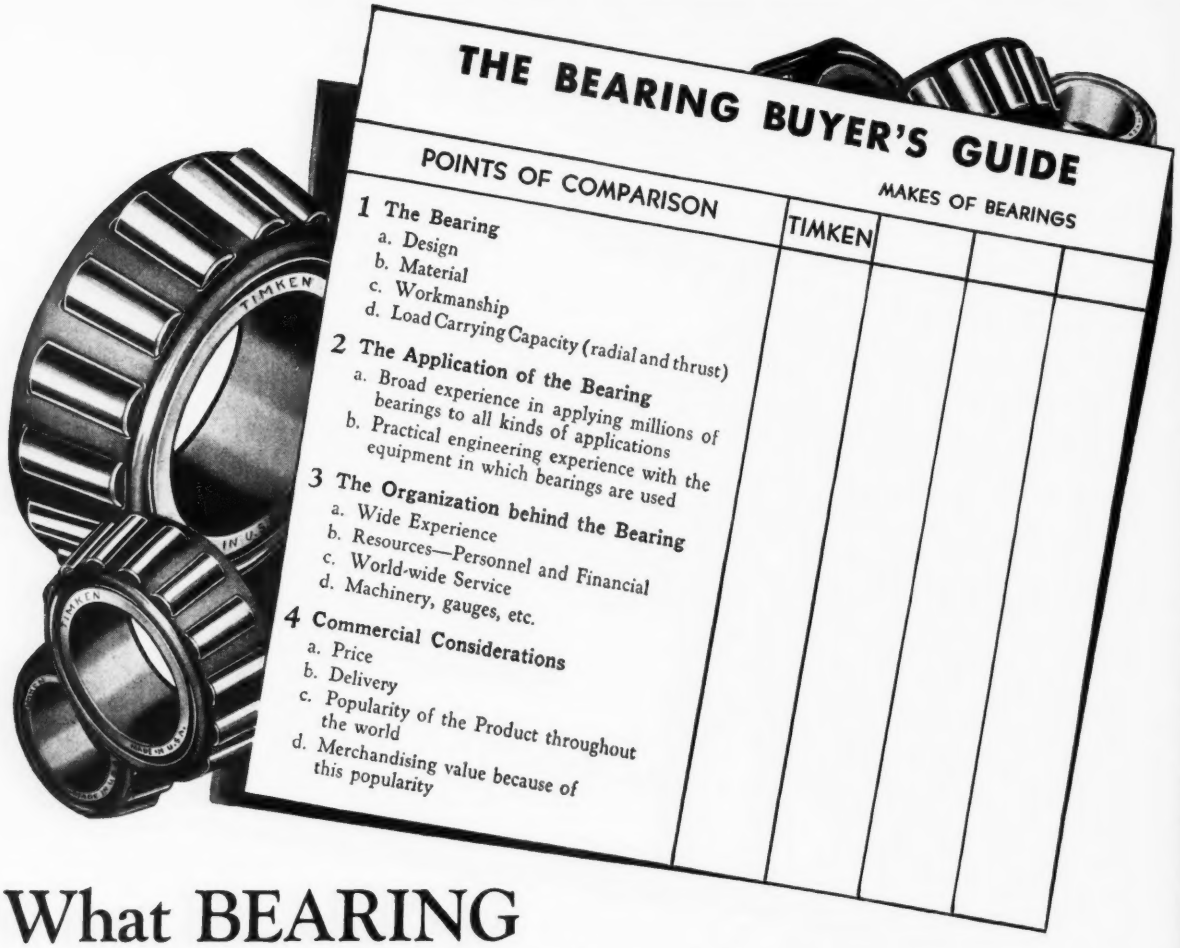
NORDBERG MAINTENANCE MACHINERY


THE BEARING BUYER'S GUIDE
POINTS OF COMPARISON
MAKES OF BEARINGS
TIMKEN
1 The Bearing
a. Design
b. Material
c. Workmanship
d. Load Carrying Capacity (radial and thrust)
2 The Application of the Bearing
a. Broad experience in applying millions of bearings to all kinds of applications
b. Practical engineering experience with the equipment in which bearings are used
3 The Organization behind the Bearing
a. Wide Experience
b. Resources—Personnel and Financial
c. World-wide Service
d. Machinery, gauges, etc.
4 Commercial Considerations
a. Price
b. Delivery
c. Popularity of the Product throughout the world
d. Merchandising value because of this popularity
TIMKEN

What BEARING Should I Buy or Specify for Railway Maintenance Equipment?

The Timken Buyer's Guide Will Tell You

There is one way to settle the bearing question conclusively—whether you are a user or manufacturer of railway maintenance equipment—and that is by a thorough and careful comparison of *all* the points likely to influence bearing service and satisfaction.

When choosing between two or more types of bearings, however, you may easily overlook important points that might make all the difference between a wise choice and an unwise one.

To enable you to avoid this we have created a buyer's guide, the use of which will place your bearing comparisons on a practical, efficient and fair basis. This is in the form of a table listing all of the points that should be considered.

In using it, each of the different makes of bearings under consideration is given a plus or minus rating opposite each of the points listed. Obviously your best bet would be the bearing having the highest percentage of pluses (and also naturally the maintenance equipment using that bearing).

It will pay you to use this guide when in doubt as to the bearings you should specify for section motor cars and trailers, inspection cars, ballast discers, power shovels, excavators, hoists or any other type of maintenance equipment.

THE TIMKEN ROLLER BEARING COMPANY, CANTON, OHIO

TIMKEN *Tapered Roller* **BEARINGS**

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